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TELEGRAPHY AND TELEPHONY IN 1914.

WHILE no startling discoveries or inventions in the field of electrical communication marked the past year, it was a period of steady progress and development. In January the International Conference on Safety of Life at Sea concluded its labours, and a Convention was signed, requiring the provision of wireless telegraph apparatus on all merchant ships that carried 50 or more persons on board; an Act was passed in August to give effect to this provision, which probably will be extended some day to all sea-going vessels.

The importance of wireless telegraphy in the service of the State was further recognised in the report in June of a Committee appointed towards the end of 1913, which recommended the establishment of a National Committee for Telegraphic Research, and of a special Research Laboratory under the control of the Committee, for the promotion of progress in telegraphy and telephony. Good progress was made with the first stations of the Imperial Wireless Chain, and the Marconi Co. completed ready for operation the powerful station at Carnarvon for trans-Atlantic communication, the corresponding station being erected in New Jersey, U.S.A. The State Service has not yet commenced work, but fortunately, as our Navy retained command of the seas, communication with all parts of the Empire has been maintained without interruption. What might have happened, however, in other circumstances was well exemplified by the destruction of the Pacific cable station at Fanning Island by a German cruiser in September, and the cutting of the cable to Jamaica on August 3rd, as well as the raid on the station at Cocos Island, which proved the undoing of the *Emden*; or by the interruption of the whole of the German deep-sea cables by our Navy.

A new four-wire telegraph cable was laid between this country and Germany, early in the year, and a four-core loaded telephone cable between Wales and Ireland—the longest cable of its kind in the world. A still longer one, however, is to be laid this year, between England and Holland—if circumstances permit of it.

The Post Office has made good progress in improving its methods with regard to both telegraphs and telephones; the Postmaster-General appointed a Special Committee to report on systems of high-speed telegraphy, and the Baudot system, which is being widely adopted in this country, was developed experimentally to sextuple-duplex between London and Birmingham, *i.e.*, six separate channels in each direction on a single circuit. Quadruple-duplex Baudot is being installed between London, Liverpool and Glasgow, and the use of phantom telegraph circuits, superimposed upon the trunk telephone lines, has been greatly extended. The standard of maintenance of the overhead lines has also been raised, reducing the number of interruptions, and the underground telegraph system is approaching completion.

In July a Committee was appointed to inquire into the working of the telegraph service, with a view to improving its economy and efficiency.

The telephone service has also shown material improvement during the past year, largely due, no doubt, to the very elaborate system of recording, classifying and analysing the faults that occur in connection with the various exchanges which has been developed by the engineering staff. This system has the advantage that the condition and progress of each district can be continuously watched, and the staffs of the various exchanges are put in competition with one another to produce the most creditable showing. The outbreak of war imposed upon the London telephone department extraordinary demands for emergency connections to Government offices, hospitals, &c., which were handled with a celerity beyond all praise.

The direct connection between the Liverpool and Manchester exchanges by junction lines proved so satisfactory, that the Post Office has decided to apply the principle in other cases where important towns are at no great distance from one another. Three automatic telephone exchanges are being equipped, and eight others are in prospect. The telegraph and telephone services are working hand in hand; in many cases it has been possible to extend them jointly to places where either service alone would have proved too costly, and the transmission of telegrams by telephone is increasing.

As regards municipal telephony, the Portsmouth Corporation agreed to sell its undertaking to the Government, whilst, on the other hand, the latter sold the plant of the National Telephone Co. in Hull to the City Council, which is now the only municipality controlling its own telephone service within the United Kingdom.

The introduction of an entirely new system of automatic telephony, employing only relays, was a notable event, which will bear fruit at no distant date; and the successful experiments with wireless telegraphy and telephony to trains in motion in the United States may prove the key to the prevention of railway accidents in the future.

In October the opening of the American Marconi Co.'s wireless service between San Francisco and Honolulu was announced.

Revised tariffs for week-end letter telegrams to the Dominions were introduced during the year, with the co-operation of the cable companies.

The outbreak of war in August, of course, affected the telegraph and telephone services severely; all channels of communication with enemy countries were at once closed, and the telephone services between this country and the Continent were cut off. All telegrams became subject to censorship, and the prohibition of the use of codes for communication with the Dominions bore very heavily upon our industries. The restriction was eventually relaxed, but the limitations still imposed upon the use of codes greatly increase the cost of cable messages.

The Postmaster-General forbade not only the use of all private wireless stations in this country, but even the possession of wireless apparatus of any kind, and numerous prosecutions followed. It is a curious circumstance, however, that the only means of direct communication with Germany that we retain in full working order is the wireless telegraph, and the German Government uses the great station at Nauen for the distribution of more or less true news regarding the war and other matters broadcast over the surface of land and water. There can be little doubt that, in addition to the German wireless stations that were captured or destroyed by our forces, the enemy's cruisers were well served by secret stations, and possibly by others on neutral territory, so long as they were able to keep the sea. Of the immense value of wireless telegraphy to the British Navy during the war there can be no question; and it is interesting to note that this is the first great naval war in which it has been possible to put it to the test.

The wreck of the cable ship *Buccaneer* in the Indian Ocean was a regrettable incident of the year, fortunately of a kind that we rarely have to record.

The value of wireless telegraphy in saving life was once more exemplified, in connection with the loss of the *Empress of Ireland*. Progress towards the solution of the problem of wireless telephony on a commercial basis was reported, but was apparently interrupted by the war.

Electrical Progress at Manchester.

To anyone who has watched it year by year, the development of electricity supply in its various phases provides a fascinating study. Though the actual generation of electricity may be attractive only to the engineer, its successful production and distribution on the grand scale of the future will involve widespread interests, of which one is apt to lose sight in a casual survey of the situation.

To say that the supply of electricity is nowadays rapidly becoming a governing factor in social economics in certain —particularly industrial—areas, is not overstating the case, although it is not commonly realised how very closely interlinked the coal pile at the electricity works and the welfare and happiness of the surrounding population in such areas are becoming, nor how manfully the electrical engineer of the past and central station manager of the present have struggled to render this state of things possible. Cramped ideas of electricity supply, begotten of village pump traditions, are gradually fading away with the realisation of the greater things in store in the future, of which the various large schemes in hand at the present time in Europe, America, South Africa, and Australia afford some indication.

Of such projects, that of the Manchester Corporation to build a 160,000-KW. generating station at Barton, just outside the city boundary, is the most ambitious at the moment in this country, and is interesting because it indicates a degree of confidence in the big generating unit, of which our central station engineers have, to some extent, fought shy in the past.

Through the courtesy of Mr. S. L. Pearce, chief engineer of the Manchester electricity department, we are able to publish elsewhere in this issue some particulars and drawings of the proposed Barton station, the outstanding features of which will be the arrangements for receiving and storing fuel, the use of semi-purified sewage for condensing purposes and the adoption of the largest size of turbine-driven machinery, while the proposed 33,000-volt underground transmission between the Barton station and the centre of the city is also a distinctive feature of the complete scheme. To those who have studied the problem, it is evident that while successive advances in the design of turbo-electric plant have removed many of the practical difficulties in the way of concentrating large electrical powers, the boiler house and its attendant coal pile have shown no corresponding progress. Even in the favoured position of the Barton plant, only some four miles from a coalfield, with which it will be connected by both canal and railway, the delivery, reception, storage, and utilisation of, say, half a million tons of coal a year at one station, is an engineering problem in itself, involving greater difficulty than the adequate supply of condensing water, and suggestive of a probable limiting factor in future large generating plants.

It will be noted that at Barton the silo system of coal storage is to be adopted, this being an unusual feature in generating station design in this country, where fuel is generally stacked in the open for storage. Each of the boiler units will be equipped with the Prat induced draught system, and the array of 48 bell-mouthed chimneys will constitute something of a record, even in the Manchester district.

The first section of the plant will comprise two 15,000-KW. turbine sets, and the plans of the complete plant include four such sets, together with four 25,000-KW. sets. Manchester already uses one 15,000-KW. turbine unit, and when

the new station reaches the stage where larger plant is required, even the 25,000-KW. turbine will have had sufficient time to demonstrate its usefulness.

Electricity supply is ever expanding, and all past experience has shown the futility of nibbling at the supply problems which will require to be faced in the near future, for which reason Mr. Pearce's scheme is a welcome departure, and it is fully justified by the wider American experience, which, after all, will be our own in a few years' time.

American central station authorities have a confident way of anticipating the future—and we are not aware that their unbounded enthusiasm in matters electrical has met with any disappointments—while by comparison we usually adopt hand-to-mouth methods, having no proper relation to prospective business, no *primâ facie* engineering basis, and which can only be explained by the timidity of those who control municipal exchequers and have not only to safeguard rates, but also to answer for their deeds to the guardian angels of the Local Government Board.

We believe that not only is this policy based on a mistaken conception of things, but that the Barton scheme will provide a much needed object lesson to those electricity authorities, municipal and private, in this country who have failed to appreciate the future of electricity supply at its true worth.

War Risk and Workmen's Compensation.

THE question whether a workman who is killed directly, or indirectly, through the action of an alien enemy is the victim of an accident arising out of, and in the course of, his employment, has already arisen. It is a question of some interest, and it is important to those concerned with the supply of electricity, inasmuch as, according to common belief, generating stations are to be objects of attack from the Germans within our gates as soon as the Germans outside have effected a landing. A bomb falling through the roof of a station might give the man at the switchboard what Mark Twain would have described as "a considerable of a jolt in the back!" The facts in the only case hitherto decided are somewhat far removed from these; but the decision is, nevertheless, interesting on general grounds. It appears that a Grimsby trawler, which had taken due note of an Admiralty warning about floating mines, discovered some of these dangerous objects in the North Sea. Having put down a buoy to mark them, the skipper was making off to warn a warship, when his vessel collided with another mine and was blown up. The engineer, having been seriously injured, prosecuted a claim for an injury alleged to have arisen by accident arising out of, and in the course of, his employment. It was contended on behalf of the respondents—the owners of the trawler—that inasmuch as the skipper had gone out of his way to warn the warship, the accident did not arise in the course of the employment. The employers had judgment, the learned County Court Judge saying: "My decision is based upon the broad principle that an injury caused by the act of an alien enemy is not an accident arising out of, and in the course of, the employment of a workman."

With all respect to the learned Judge, we think he stated the principle rather too broadly. Indeed, the fact that the County Court decision has been reversed on appeal fully justifies this view. Suppose the trawler had been on her "lawful occasions," and had then been blown up by a mine, so far as the engineer was concerned he would have been the victim of an accident just as much as if he had suffered from a peril of the deep. Applying this principle, the victim of a bomb thrown from a hostile airship on to a generating station would clearly have suffered an accident "in the course of his employment." The further question is: Did it arise "out of" the employment? This appears to depend on whether there was special exposure. We know of two cases in which special exposure has enabled a workman to recover. In one of these (Challis *v.* L. & S.W. Rly. Co.) an engine driver was injured by a stone thrown by a boy from a bridge under which his train ran. It was shown to be a common practice for boys so to throw stones. The accident was held to have arisen out of the employment. In another case (Nisbet *v.* Rayne & Burn) a cashier carrying money in a railway for the payment of colliery wages was murdered. It was held that there was special exposure to risk of attack, and that the accident arose out of the employment. As it is the duty of an engineer to be at a post of danger, it seems to us that the station engineer injured at his post by a bomb from an airship, or a shell from an anti-airship gun, might well be able to make a claim for compensation.

Rubber.

THE old year having come to an end one can take a dispassionate glance back over the twelvemonth, which has been a period of exceptional anxiety for all. Production has inevitably suffered from the world upheaval promoted by the Huns, and the result is that whereas it had been thought that 1914 might and probably would see a large increase in the rubber output of the world, so far as has been revealed at present, output was about stationary. It is calculated by Messrs. Gow, Wilson & Stanton that the production during 1914 totalled 107,000 tons, which is approximately the same amount as in the previous year, but there has been a distinct falling off in the yield of wild rubber areas, and a considerable gain therefore in the output from the plantations. It is estimated that last year's total of plantation rubber was 65,000 tons, compared with no more than 46,000 tons in 1913, and the growing importance in a relative and also in an actual degree of the plantation crops is thus unmistakeable. There do not appear to have been any great or appreciable strides made in the development of synthetic rubber, from which so much has been feared at one time and another, but there will be continual research work and more or less costly experiments no doubt. Price is, however, against synthetic rubber. It needs extravagant rates to justify and encourage experimental work on a large scale, and these prices are not now to be had for genuine rubber let alone for imitations.

There is no reliable information to be had in respect to the real statistical position, which is a good deal overclouded, partly in consequence of the embargo on exports. Considerable quantities of rubber are stored in public warehouses in both London and Liverpool, but a portion of this is merely held there awaiting export permits, so that it would be unwise to treat the warehouse returns as representing the real position of the commodity. There is very little to talk about in connection with the trade demand. Naturally things have been very quiet over the holidays, while prices are much about as they have been of late, and stand not far off the lowest points of last year. During 1913 standard crepe at one time touched 3s., but sold down to 1s. 11½d., which was also the lowest figure in 1913, while prices are close upon this now. The poorness of the market lately has been caused entirely by the financial and commercial difficulties brought about by the war.

The news from the United States is not very cheering. Nevertheless there has been an improvement during the last few weeks, and the most has been made of the resumption of operations at the Hartford Rubber Co.'s plants at Hartford and Providence. Both of these had been idle for several months, partly because there had been a number of scares threatening the supply of crude material. Under those circumstances the management decided to close down the works, and use up the reserves of tires and other finished goods. The stocks in this direction have now been greatly reduced, and the resumption of work is the natural result of the improved position in this respect. The American tire plants have booked a number of large orders for solid tires for the armies of the Allied nations in Europe, and the tire plants of the United States are now rapidly getting to work at full capacity.

The latest details to hand show that the exports of plantation rubber from the Straits Settlements (not including the Federated Malay States) for the 11 months—January to November—of last year totalled 17,393 tons, against 10,672 tons in 1913, and 5,242 tons in 1912.

HIGH-VOLTAGE DANGERS PRESENT IN STATIC TRANSFORMERS DUE TO ELECTROSTATIC CAPACITY OF THE WINDINGS.

BY J. LINDLEY THOMPSON, M.Sc., A.M.I.E.E., and S. AUSTEN STIGANT.

(*Concluded from page* 26.)

Now take the case of a transformer earthed at any high-pressure phase point and with core and low-pressure neutral earthed as shown at fig. 6*a*. With simply the above conditions, but the high-pressure windings completely unearthed, the potential diagram would be as shown at fig. 5*b*, but

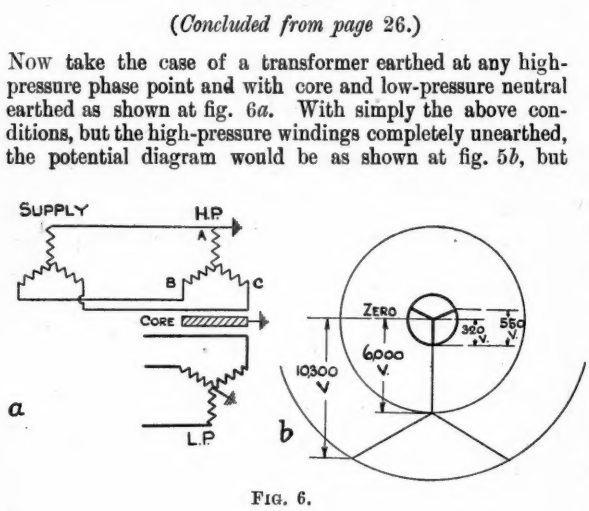


FIG. 6.

immediately any point of the high-pressure winding becomes earthed, that point drops to zero potential and a corresponding rise of potential takes place at the other terminals, as shown at fig. 6*b*. As will be seen then in this case with earthed high-pressure winding at A, the terminals B and C are (at a certain definite instant) at a potential of 10,300, or full line volts below earth with the neutral point at 6,000 volts below earth, where previously (at the same instant) the high-pressure terminals B and C were only at 6,000 volts $(10{,}300/\sqrt{3})$ below earth and the neutral point was at zero potential. It should be particularly noted here that no rise of potential can possibly occur on the low-pressure winding due to electrostatic conditions *when the low-pressure neutral is earthed*.

Taking now the cases before mentioned (*a*) and (*b*), fig. 7 shows diagrammatically a three-phase star/star transformer with earthed neutral supply and unearthed high and low-pressure transformer windings. The *average* potential of each high-pressure phase winding will equal line voltage $\div 2 \times \sqrt{3}$, assuming even distribution of windings. Then since the capacities of high-pressure winding to low and low to core are equal, as the high-pressure supply neutral is earthed, the low-pressure winding being open-circuited will assume a static potential to earth equal to the high-pressure average phase voltage. This value, as with single-phase

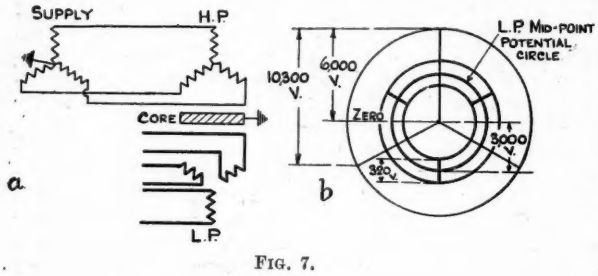


FIG. 7.

transformers, will be much in excess of its normal working pressure, and will present the same danger as in the cases previously cited, though, at the same time, probably being much lower than in the instance of uneven switching.

Turning now to the case of uneven switching, if one pole of the three-phase high-pressure supply be connected to the transformer winding, then the whole of the high-pressure winding assumes a potential above earth equal to the full line voltage. Supposing also, in this example, that the low-pressure windings are all disconnected from each other, as would be the case for instance in a transformer for supplying a six-phase rotary, then the low-pressure windings would assume a potential above earth equal to—

$$V = V_1 \times K_1/(K_1 + K_2),$$

where V_1 = full high-pressure line voltage. This potential would, in most cases, be of a very high value, and would most probably puncture the low-pressure insulation to core, assuming that the core is earthed. And as with single-phase transformers, although this puncture would not necessarily at the time produce disastrous results, the presence of this defect in the insulation would soon become apparent under normal working conditions, by presenting an earth at an unintended point, and thus bringing other parts of the low-pressure windings to definite voltages above earth, which voltages may be dangerous to human life. Fig. 8 *a* and *b* diagrammatically represent these conditions due to uneven switching.

Before passing on to other conditions of operation, it will be profitable to study a little further the danger to human life and apparatus, which will be present, due to a failure of insulation between high and low-pressure windings occasioned by electrostatic pressure as described in fig. 8. Suppose the high-pressure supply has its neutral earthed. Then upon completion of the switching operation, the fault above-mentioned having occurred, the low-pressure windings at this point of the breakdown, and therefore throughout, will assume a potential to earth equal to that existing between the high-pressure fault and earthed neutral. The value of this potential will depend on the exact position of the breakdown on the high-pressure windings, and this it will be readily seen will be excessive compared with the normal low-pressure voltage. Since the insulation of the low-pressure winding is generally very substantial for mechanical reasons, a breakdown of the low-pressure winding

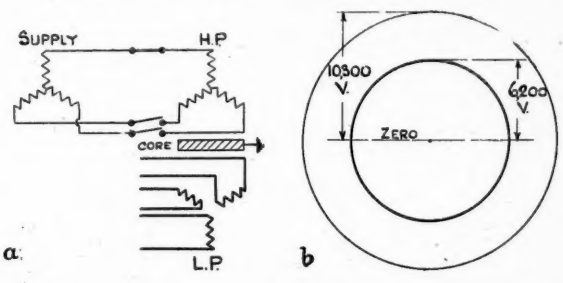


FIG. 8.

to earth will not necessarily occur. With these conditions existing and the low-pressure winding switched on to its load mains, all apparatus on these mains is subjected to this high-pressure voltage. Here lies the grave danger to human life and apparatus, which follows as a consequence from the original static breakdown as fully explained above. As an example of this danger, it will be worth while to quote a disastrous breakdown which occurred to a large electric rolling mill plant with which the authors were acquainted.

The plant consisted of a large 3/6-phase transformer supplying a rotary converter, which, in turn, supplied the large D.C. low-speed rolling mill motor. A fairly large induction motor for barring gear purposes was also supplied from the low-pressure side of the transformer. The transformer was supplied from a high-voltage three-phase main with an earthed neutral. The low-pressure windings of the transformer were unearthed. Due to some inexplicable cause, the high-pressure windings broke down to the low-pressure windings, and these for a time maintained their insulation to earth. The low-pressure windings of the transformer being connected in the usual way to the rotary, passed on the high pressure which they assumed from contact with the high-pressure windings, and so all the load circuit became subjected to this high pressure, with the result that breakdowns to earth occurred in the stator windings of the induction motor and at one point of the field windings of the large D.C. motor.

This breakdown to earth completed a circuit which was virtually a short-circuit across the breakdown point of the high-pressure windings and the earthed neutral, with the result that a heavy current flowed round this circuit, causing extensive damage.

The failure beyond that of the transformer, it will be seen, was due to the neglect of earthing the low-pressure side of the main transformer in an effective manner. Fortunately, no human element came into contact with live parts during the breakdown, but, nevertheless, danger existed and also expensive repairs were entailed.

In all the cases previously mentioned, the diagrams have been taken on the basis of the transformer core being earthed, which procedure should be followed in all cases as before mentioned. If for some reason or other the core is unearthed, a further electrostatic potential will exist between the core and earth, and since the core is usually connected to, and earthed from, the transformer tank, then the tank will also assume this same static potential. The danger due

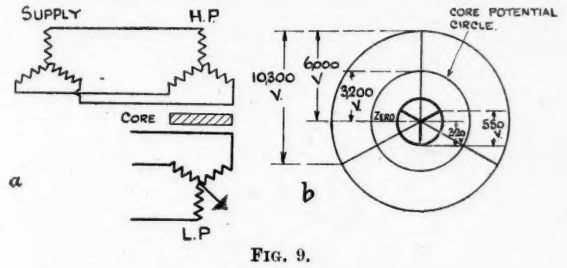


FIG. 9.

to this possibility will be readily appreciated. With regard to this point, it will be interesting to cite a case which came under the authors' notice, in which a 500-K.V.A. transformer having a voltage ratio of 6,500/440 volts and connected star/delta was supplied with high-pressure voltage in a non-symmetrical distribution. It was found on measuring with a static voltmeter that the core of the transformer had assumed a potential above earth of 3,500 volts. Commensurate then with this value we can take the core in our particular case to be at a potential of 3,200 volts above earth, for due to greatly varying external factors, it is practically impossible to calculate the capacity of core to earth. Fig. 9 *a* and *b* illustrates the condition of affairs, and, as will be seen, with the low-pressure neutral earthed that winding remains unaffected by electrostatic potentials. Similar static potentials would result with two-phase transformers with the mid-wire earthed and the secondary winding open-circuited, or, again, with one of the outer wires earthed and the secondary winding open-circuited or connected for three-wire operation.

For a final example, let us take the case of an accidental breakdown to earth of one phase of an unearthed high-

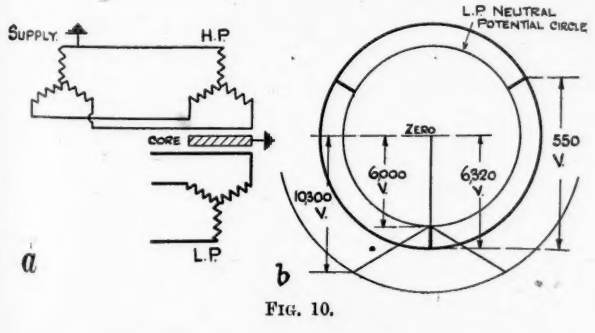


FIG. 10.

pressure three-phase system supplying a step-down transformer operating with unearthed high and low-pressure windings, as shown in fig. 10 *a*. Assuming that the earth fault occurs in one of the high-pressure supply cables, then that end of the transformer phase winding which is connected up to the supply system by the faulty cable in question immediately falls to zero potential, and the other two high-pressure terminals assume the full line potential of 10,300 volts, the neutral being at 6,000 volts below earth. Then, as the average potential of the high-pressure winding is that of the neutral, the low-pressure neutral will, due to the earth connection on the supply cable, assume this average potential of 6,000 volts, while the low-pressure terminals will be at a potential of the normal ratio volts above this value, viz., 6,320 volts, as shown in fig. 10 *b*.

From the several foregoing examples it will be an easy matter to ascertain the precise electrostatic conditions engendered in any particular system, the same fundamentals applying for delta and other connections as above enumerated for star.

In conclusion, the authors would point out that to safeguard against this accumulation of excessively high electrostatic potentials on the low-pressure windings, and consequent danger to insulation, it is necessary either to (1) solidly earth the low-pressure mid-point or one of the low-pressure terminals, or (2) earth through a multiple spark-gap or static earthing device. The advantage, chiefly on account of human safety, apart from the reduction of stresses in the insulation, lies, in the authors' opinion, with the static earthing device, since this apparatus only causes an earth when the high static potentials exist and not during normal operations. The danger to the human element if it should accidentally come into contact with the low-pressure winding is much less than if a solid earth were existent, causing a definite voltage *always* to be maintained above earth, particularly if the earthed point was one terminal of the low-pressure winding.

Regarding the diagrams, it will be seen that the vectors and curves representing the low-pressure potentials are necessarily drawn to a larger scale than those representing the high pressure, as the ratios above taken are too small to conveniently allow of the use of the same volts per inch scale.

AUTOMATIC PROTECTIVE SWITCHGEAR FO AUTOMATIC CURRENT SYSTEMS.

By E. B. WEDMORE, M.I.E.E.

(Abstract of paper read before THE INSTITUTION OF ELECTRICAL ENGINEERS, *Dec. 10th,* 1914).

THE use of protective devices acting selectively to cut out faulty sections will not only ensure continuity of supply, but by enabling faults to be cleared quickly and whilst only a small current is flowing, will greatly reduce their destructive effects.

On plants rated at more than 20,000 KW. the systematic employment of selective devices throughout is commercially almost a necessity. On much smaller plants it is not sufficiently recognized that the use of selective protective devices often enables economies in the expenditure on cables to be effected, which alone will more than cover the expenditure on the apparatus.

If the selective apparatus employed is of a type independent of the arrangement of the cables the distribution network can be laid out on the most economical principles, unhampered by the limitations of reverse-current relays and similar apparatus.

Fig. 1 shows the elements of which distribution systems are constructed, and will serve to define the terms employed.

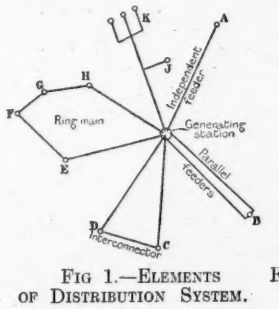


FIG 1.—ELEMENTS OF DISTRIBUTION SYSTEM.

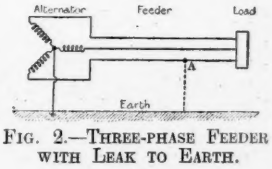


FIG. 2.—THREE-PHASE FEEDER WITH LEAK TO EARTH.

The supply to the point A is through an independent feeder. The supply to B is duplicated by the use of parallel feeders, whilst that to C and D is duplicated by the use of an interconnector. The ring main, feeding points E, F, G, and H,

is a combination of feeders and interconnectors. At each distribution point the circuits supplying individual motors, etc., are independent feeders.

All distribution systems are built up of combinations of the above. Independent feeders may be branched as at J and K.

PROTECTION OF INDEPENDENT FEEDERS.

In the case of independent feeders it is impossible to remove the fault without causing a temporary loss of supply to that part fed by the faulty feeder; but trouble should be confined to the part in question. Fuses are satisfactory for small circuits, but are replaced by automatic circuit-breakers on large circuits. In order to prevent loss of supply it is necessary to adjust the overload devices to withstand perhaps several times normal load. Such an arrangement necessitates all faults being retained on the circuit until they become heavy faults, and it may allow of serious injury to the plant on a sustained overload. This difficulty is partly met by the use of time-limit overload devices.

A leak may occur between poles or to earth. A leak between poles generally develops into a short-circuit, and the case is met by the use of overload devices.

A leak to earth may not cause overloading, and thus may continue for a long time on a circuit protected only by overload devices. This introduces a risk of fire or shock, serious in mining work and undesirable in all cases. In case the the leak is through combustible insulating materials, as in machines or cables, it will probably develop into a short-circuit between phases. On large distributing systems it is becoming increasingly important to provide means for disconnecting, before the short-circuit stage is reached, sections on which there are leakages.

Fig. 2 represents an independent 3-phase feeder having a leak to earth at the point A. It will be observed that prior to the leak all current going out through one of the conductors must return through the others, and that the sum of these currents must be zero. When a leak occurs, however, some of the current returns through the earth and the balance of the currents in the three conductors is no longer zero. This principle has been known for many years, and it is remarkable that it has only recently been applied in the design of automatic switchgear.

The principle finds its embodiment in protective switchgear of the core-balancing type, so called because the currents in the several cores in one cable are balanced. In one form a current transformer is furnished with a core surrounding the

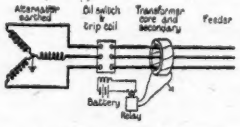


FIG. 3.—FEEDER PROTECTED BY CORE-BALANCING TRANSFORMER.

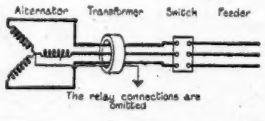


FIG. 4.—SOURCE OF SUPPLY PROTECTED BY CORE-BALANCING.

feeder conductors as in fig. 3, which conductors form the primary winding. The secondary is connected directly through a relay to the circuit-breaker. Such devices are obtainable adjustable to operate on a leak of a few amperes.

In another form separate transformers are furnished, one in each conductor, and the tripping device is connected in a common return circuit. With this arrangement direct-acting trip coils can commonly be employed, operating at about one-third normal load, and the same transformers may be employed to excite instruments and to operate the usual time-limit overload devices which are still necessary to protect the system against faults between phases and heavy overloading.

A sensitive leakage device is of great value and should be used universally on independent e.h.t. feeders, and on high-tension service where current transformers are available. The arrangement not only ensures the early disconnection of faulty circuits, but enables the fault to be removed from the system with a minimum of disturbance.

On 3-phase systems having the mid-point earthed through a current-limiting resistance the core-balancing system allows the use of a resistance of high ohmic value, positively limiting the fault current to earth to a relatively small figure. Where core-balancing devices are not employed, the earthing resistance must allow a sufficiently large current to pass to operate the overload devices with the highest current settings which may be employed on the system.

The introduction of core-balancing apparatus enables selective action to be obtained to an extent quite impossible with overload devices.

The settings of the automatic devices in series between the generators and the local supply circuits can be graded in large steps of current and time without sacrificing the requirements at either end.

The difference in time setting between two consecutive switches must be sufficient to admit of one switch completely disconnecting the circuit before the other commences to operate. The total will generally lie between ½ second and 1 second according to the design. To this must be added a margin for safety.

All 3-phase systems have mid-point earthed through the star-connected condensers formed by the capacity of the cable, and on a fault to earth a corresponding capacity current will flow which may be quite sufficient to operate core-balancing apparatus.

If an earthing resistance is used, as is generally the case on e.h.t. systems, the resistance should not pass less than 50 amperes or 100 amperes on high-tension and medium-tension systems. In practice the current required is generally higher than this on account of the higher settings of the automatic releases in large generator switches.

It has been shown that the use of leakage devices on feeder circuits has many advantages, and it remains to say that when core-balancing apparatus is applicable it will always give better results than overload devices.

LEAKAGE PROTECTION FOR SOURCES OF SUPPLY.

The core-balancing principle has been applied recently to independent feeders conveying current from sources of supply. If the conductor from the generator's neutral point to earth is included in the core-balancing transformer as in fig. 4 it will be found that the transformer is now unaffected by a feeder fault, but is affected by a fault in the machine or on the machine side of the transformer. Thus core-balancing apparatus will cut out an individual faulty load circuit or source.

This arrangement can be applied to any source having one point earthed, for example a transformer, or a 3-phase machine with one pole earthed. It gives a very simple solution in the case of Scott-connected transformers feeding a 3-phase 4-wire system, but it is not a general solution of the problem of completely protecting sources of suply, as it is operative only on faults to earth. It gives complete protection only if the design of the apparatus protected is such that a breakdown must involve an earth fault and cannot occur simultaneously on all the phases.

PROTECTION OF PARALLEL FEEDERS.

The familiar and primitive solution of this problem lies in the use of time-limit overload devices at the end nearest the generating station, and reverse-current devices at the remote end of each feeder. When a fault occurs near the remote end of one feeder the current may be shared nearly equally between them. The current flowing back into the fault from the common point at the remote end will actuate the reverse relay on the faulty feeder and thus relieve the sound feeder. The time-limit overload devices prevent the disconnection of the feeders until the reverse-current device has separated them at the remote end, thus concentrating the fault on the faulty feeder.

In addition to the disadvantages attaches to the use of overload devices, this combination possesses several others inherent in the use of simple reverse-current relays that depend for their discriminating action on the use of potential windings.

Several attempts have been made to get over these difficulties, and although not one of them presents a general solution of the problem they are worthy of further consideration.

Perhaps the most important device is that which has been described as interlocking and is based on the principle that parallel feeders of the same length, make, and cross-section will normally share the current equally.

The essential feature of the interlock is the establishment of a relationship between the apparatus and the circuits such that the apparatus cannot operate to cut out the circuits unless the balance of current between the circuits is destroyed.

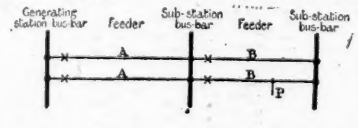


FIG. 5.—SUB-STATION FED THROUGH PARALLEL FEEDERS.

Fig. 5 shows two sub-stations fed in series through pairs of parrallel feeders A, A; and B, B, from a generating station, the feeders being protected by overload devices at the points marked X.

If the overload devices in each phase are interlocked as described above, they will be unaffected by any fault on the system other than one in the individual pair of feeders. For example, a fault in either sub-station will be fed equally through the feeders in either pair whether from the source of supply or from running machinery returning current. If a fault occurs at P in feeders B, B, the feeders A, A, will still carry equal currents,and only feeders B, B, will be affected.

A further device is required to discriminate between the two feeders B, B, and this may be obtained by arranging that the more heavily loaded feeder shall be cut out, for it will be seen in the example illustrated that the faulty feeder will carry most of the fault current.

Fig. 6 shows diagrammatically a relay having the required characteristics. The operating coils are excited respectively from the two feeders, and the balance arm is biased to the

middle position. So long as the currents are equal the balance arm will be unaffected, but with an increase of current on one side the arm will be drawn down on that side and will close the corresponding pair of contacts to trip the switch in the feeder on that side.

On the faulty feeder being disconnected, the other becomes the more heavily loaded and some device is required to prevent its being disconnected. The only sound method is to employ auxiliary switches on the oil-switch mechanism to bring the coils into action automatcally. Satisfactory service has been given by such a device which automatically converts the protection into time-limit protection on one feeder on the failure of, or the deliberate disconnection of, the other.

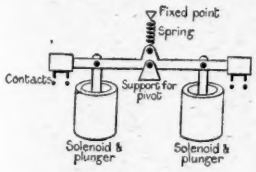


FIG. 6.
BALANCED OVERLOAD RELAY.

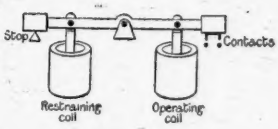


FIG. 7.
BIASED PROTECTIVE RELAY.

In practice a perfect balance of current between the feeders is not obtainable and there will be an appreciable excess current on one side or the other on a severe overload. The balancing difficulty can, however, be completely eliminated by a simple device which has been employed successfully on E.H.T. service. Each feeder is furnished with a relay having two elements, one an operating element and the other a restraining element, as for example in fig. 7.

The operating coil is excited from the feeder which is being protected, and the restraining coil by the feeder in parallel with it. The arrangement is biased in favour of the restraining coil to the extent of say 10 per cent., by placing extra turns on that coil so as to make it more powerful than the operating coil by 10 per cent. Now unless the balance is upset by more than 10 per cent. the device cannot operate, and yet at normal load the device tends to operate immediately the fault current exceeds 10 per cent. of the normal load current. This eliminates all errors in balancing, whether in the relays, current transformers, or feeders, and also the maintenance of balance.

As interlocked overload relays are proof against overloads or faults occurring outside the parallel feeders protected, it will be seen that they are particularly suitable for the protection of a number of stations in series. All the devices may be set to operate instantaneously and at less than the normal load current, and yet none of them will operate except in the faulty section.

Another method of eliminating the balancing problem is by the use of leakage relays interlocked in the same way as overload relays. These relays, as previously described, operate only on faults to earth, of which the extent can be limited by an earthing resistance. The relay settings will be in the neighbourhood of the maximum fault current, and thus even a 10 per cent. unbalancing is quite negligible. Seeing that most cable faults are faults to earth, and that of the faults between phases most develop first or simultaneously as faults to earth, this arrangement will successfuly remove the large majority of feeder faults and is proof against disturbances from other sources. Two feeders can be protected by one relay instead of requiring three or six.

It will be understood that as leakage relays are inoperative on faults between phases, their employment only reduces disturbances, and the most severe disturbances, namely, those due to faults between phases, are left to produce an extensive or complete shut-down. The addition of interlocked leakage relays to a system otherwise protected by overload relays will improve the conditions but cannot be considered a real solution of the problem of protection.

Reverse-current relays are now obtainable which will operate at about 3 per cent. of the normal working voltage and over a wide range of power factor, but below this voltage they are inoperative on currents of any magnitude. On a fault which develops practically instantaneously and reduces the voltage below this limit, the relays will be of no service.

The difficulty due to loss of voltage has been dealt with by making the moving parts unstable at low voltage, so that any movement initiated is completed. At full voltage the moving parts must be stable so as to ensure restoration of the relay and freedom from trouble due to vibration and sudden changes of load. Such relays have given satisfactory operation for a number of years. These improvements render the reverse relay almost independent of voltage. The application of the interlocking idea renders them unaffected by current fed back from sub-station plant and of surges in either direction.

Whilst well-designed reverse-current relays with potential windings will deal successfully with the majority of faults, it is to be noted that the faults with which they cannot cope are just those likely to occur as the result of bad design, bad workmanship, defective material, and carelessenss, and are also those most disastrous in their results.

PROTECTION OF INTERCONNECTORS AND RING MAINS.

As the energy flow in a sound interconnector or ring main may be in either direction, varying with the distribution of load, reversal is no longer a sign of leakage. A leak of sufficient magnitude may so disturb the distribution that energy may flow into the faulty conductor from both ends. This condition is a sure criterion of a heavy fault. Attempts have been made to utilize this feature to obtain selective action.

A pilot wire may be employed to take a sample of current from one end of the feeder to the other for use as a standard. The current at the remote end may then be compared with the sample to determine whether the direction or magnitude of flow is the same. The latter is the better course as the magnitude changes with the smallest leakage, but the direction will only change with a relatively large leakage.

This is the basis of the well-known Merz-Price protective system.

Current transformers are inserted at the two ends of the conductor to be dealt with and are connected through the

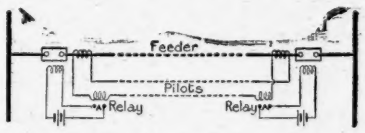


FIG. 8.—PROTECTION OF INTERCONNECTOR BY BALANCED VOLTAGE SYSTEM.

pilot wires. In the balanced-voltage system diagrammatically illustrated in fig. 8 the current transformers are connected in opposition and the relays in series with them. In the circulating-current system illustrated in fig. 9 the transformers are so connected as to circulate the current between themselves under normal conditions. The trip coils are connected in shunt between equipotential points and carry only the difference current corresponding to the leak. The balanced-voltage system is best adapted for feeder protection and the circulating-current system for the protection of transformer and generator windings, for all of which applications well proved designs are available. There is no better method of protecting existing feeders, and all generators and transformers.

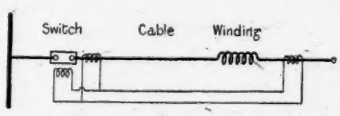


FIG 9.—MACHINE WINDING AND CABLE PROTECTED BY CIRCULATING-CURRENT SYSTEM.

GENERAL SOLUTION OF THE PROBLEM OF FEEDER PROTECTION.

Any arrangement capable of dealing with a single interconnector can be applied to any cable in the system. The Merz-Price system is applicable to interconnectors, and is therefore a general solution of the problem.

A general solution has the immense advantage that one can ignore the protective gear when laying out the cable system, and that each and every feeder can be protected in a similar manner and by a self-contained combination of similar apparatus independently of all other feeders.

The split-conductor protective system is up to the present the best solution of the problem, for not only does this solution give an arrangement applicable to ring mains, interconnectors, and duplicate feeders—in fact, to all systems of distribution—but it gives an arrangement absolutely selective and so sensitive as to perform this function instantaneously at a fraction of the normal load current.

The system requires the employment of a cable of special construction, or in the case of overhead lines a special arrangement of conductors. The construction involves but a slight departure from that commonly employed, and consists in the splitting or separating of each conductor into two parallel portions lightly insulated from one another.

Fig. 10 herewith illustrates a standard 0.1 sq. in. cable suitable for 20,000-volt distribution. Fig. 11 illustrates a similar cable constructed for use under the new system, and it will be seen that each core is split (hence the name). The cable is constructed with an oval concentric core, this construction giving the best distribution of potential strain in the insulation. In small sizes this is especially valuable, and dispenses with the necessity for a hemp core within the copper conductor. Such cables are being manufactured at a cost but slightly exceeding that of the standard pattern, suitable for a wide range of voltages and currents.

The principle of the system is illustrated diagrammatically by fig. 12, which shows the connections for one split conductor. The split conductor is connected at each end to the usual switchgear equipment, consisting of oil switch, busbars, etc., through a special current transformer. The current-

transformer core has two primary windings, to which the two halves of the split conductor are connected, and the core carries also a secondary winding connected to a relay controlling the oil-switch trip coil.

Under normal conditions, as in fig. 12, current entering the feeder at one end divides equally between the two parallel paths, being united again on the remote side of the

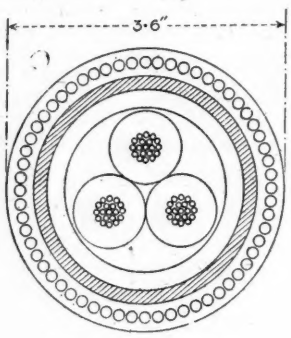


FIG. 10.—STANDARD 20,000-VOLT. 0.1 SQ. IN. CABLE.

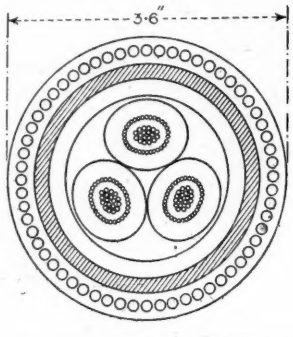


FIG. 11.—STANDARD 20,000-VOLT 0.1 SQ. IN. SPLIT CONDUCTOR.

second current transformer. In each transformer the magnetizing effects of the two primary coils are equal and opposite, thus the transformer offers no impedance to the current flow, and the secondary windings and relays are unaffected.

In case, however, a fault develops, for example at the point A in fig. 13, the fault current flowing towards A will

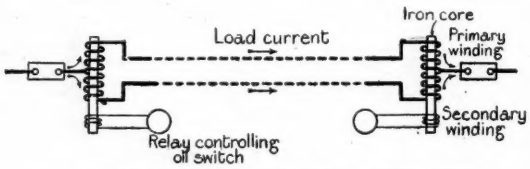


FIG. 12.—SPLIT-CONDUCTOR SYSTEM—SOUND FEEDER.

upset the balance of current between the two primary windings in each transformer, thus producing a magnetizing effect on the secondary windings and exciting the relays.

The transformers also serve a second function in case the fault occurs near one end of the split conductor, as at B in

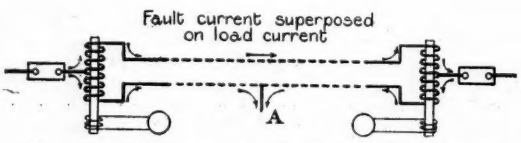


FIG. 13.—SPLIT-CONDUCTOR SYSTEM—FAULTY FEEDER.

fig. 14. In this case the fault current flowing from the left-hand end would divide equally between the two halves of the cable, were it not for the impedance of the transformer near B. The fault current flowing to B through the sound conductor traverses the two primary windings at B in the same direction, thus highly magnetising the core. The impedance so offered hinders the flow of current through the sound conductor and thus upsets the balance at the remote end, causing the simultaneous operation of both relays.

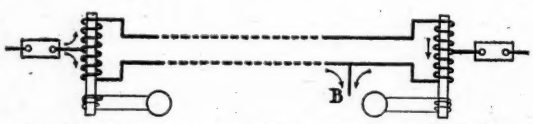


FIG. 14.—SPLIT-CONDUCTOR SYSTEM—FAULT AT ONE END.

As the cores are not magnetized under normal running conditions, there is no core loss. In practice the core is of circular form, and the primary and secondary windings are superposed.

On reference to fig. 14 it will be seen that the arrangement is more sensitive at the end nearest the fault, as the whole fault current passes through the adjacent transformer winding in one direction. Advantage is taken of this to make the whole arrangement more sensitive by employing an oil switch with split contacts which separate the two halves of the conductor on breaking circuit. The switch nearest the fault will operate first, and on separating the conductors the whole fault current is then concentrated on one conductor at the other end, and brings out the switch there also.

This system is readily applied to overhead lines. In this case the half conductors may be run as separate overhead lines on the same posts.

As a general solution, however, the twin conductors are carried on common insulators and but lightly insulated one from the other. Spacers of insulating material are inserted at intervals between supports to keep the wires apart. Fig. 15 is an enlarged detail of the insulators. If a wire is broken and falls to the ground the line will be cut out even though the fallen line fails to make a good earth. This adds materially to the protection of the public.

FIG. 15.—DETAILS OF INSULATOR.

The simplicity of this arrangement should be noted. There are no pilot wires and no potential transformers. The relays are plain overload devices requiring no special adjustment. The transformers can generally be built with bar primary windings, a construction which gives the maximum of simplicity and safety. The secondary windings are subjected to no forces except on the occurrence of a fault in the individual feeder which has to be protected, however severely the system may be disturbed.

It is difficult to connect up the apparatus incorrectly, but should the connections be crossed by mistake the switch will open immediately any attempt is made to put the feeder into service, and thus the mistake will be discovered.

It is not essential that the conductor should be divided into equal sections. If one section be made smaller than the other, say reduced to a single wire, this wire may be carried always within the other portion which will surround it. Any fault to earth or between phases must occur on the outer portion; thus it is unnecessary to provide for excess current in the inner portion.

We may now substitute a relay of the balanced type shown in fig. 7. We connect the restraining coil to the inner wire and the operating coil to the outer conductor. The relay may be biased to an extent which fully covers all possible unbalancing, thus removing all occasion for balancing tests.

This arrangement is not quite so good as that above described, as the transformers cannot be constructed with bar primary windings, that for the fine wire requiring a multiple-turn primary. On small installations such as colliery and industrial plants where the conditions accompanying short-circuits are not so severe as they are on the large power supply schemes, this objection disappears, and advantage may be taken of the cheapening of the cable and the elimination of balancing. This applies equally where such plants receive supply from the power companies, as the severest short-circuit conditions are only met with near the generating stations.

The balancing problem now presents no difficulties, although in the experimental stage some were experienced. It is necessary to balance both the reactance and the resistance of the twin conductors as it is the vector difference which is operative. This requires no attention in overhead lines, and is successfully accomplished by the adoption of simple precautions in the manufacture of the cables.

To meet all the requirements of electric supply there are now available a series of devices simple in character, well proven in service, and giving a degree of protection hitherto quite unattainable. The series is as follows:—

(*a*) For the protection of all closed feeder circuits—the split-conductor system.
(*b*) For the protection of all open-ended feeder circuits, core-balancing system.
(*c*) For the protection of generators and banks of transformers—the circulating-current system.

The advantages of the above combination may be summarized as follows:—

1. All the apparatus is simple in character.
2. All the apparatus is self-contained and completely independent of that on other circuits.
3. All the apparatus may be adjusted before installation.
4. No feeder pilot wires are required.
5. The relays are all simple contact-making devices operating on excess current and are of the same character throughout. In many cases direct-acting trip coils can be substituted.
6. The relays are not subjected to any forces until they are called upon to operate.
7. None of the devices are affected by surges.
8. None of the devices are affected by variations of voltage or of power factor.

9. None of the devices is affected by faults occurring outside the sections controlled.
10. All the devices will deal with faults between phases or to earth on systems with any number of phases.
11. All the devices are instantaneous in operation.
12. All the devices will operate at currents comparable with and generally materially less than the normal load current.
13. If incorrect connections are made this will be discovered on the first trial run.

TRADE STATISTICS OF NEW ZEALAND.

THE following figures, showing the imports of electrical and allied goods into New Zealand in 1913, are taken from the official statistics which have just reached this country. The comparative figures for the previous year are added and increases or decreases noted. Reference to these returns also appears on page 57 of this issue. It should be understood that the countries to which the goods are credited are not in every case the countries of manufacture, but merely those from which the goods are invoiced.

	1912. £	1913. £	Inc. or dec. £
Leather belting.—			
From United Kingdom ...	4,000	3,000	— 1,000
,, Other countries ...	1,000	2,000	+ 1,000
Total	5,000	5,000	—
Belting other than leather.—			
From United Kingdom ...	26,000	35,000	+ 9,000
,, Australia	1,000	2,000	+ 1,000
,, United States ...	2,000	3,000	+ 1,000
,, Other countries ...	2,000	—	— 2,000
Total	31,000	40,000	+ 9,000
Engine packing.—			
From United Kingdom ...	13,000	13,000	—
,, Australia	2,000	2,000	—
,, Other countries ...	5,000	5,000	—
Total	20,000	20,000	—
Rubber goods.—			
From United Kingdom ...	4,000	3,000	— 1,000
,, Australia	10,000	8,000	— 2,000
,, Other countries ...	2,000	2,000	—
Total	16,000	13,000	— 3,000
Scientific instruments.—			
From United Kingdom ...	8,000	7,000	— 1,000
,, Other countries ...	5,000	4,000*	— 1,000
Total	13,000	11,000	— 2,000
* Includes Germany £1,600.			
Rails.—			
From United Kingdom ...	153,000	191,000	+ 38,000
,, Belgium	5,000	—	— 5,000
,, Other countries ...	3,000	7,000*	+ 4,000
Total	161,000	198,000	+ 37,000
* Includes Australia £3,000.			
Telegraph and telephone wire, iron.—			
From United Kingdom ...	7,000	11,000	+ 4,000
Electrical machinery.—			
From United Kingdom ...	274,000	307,000	+ 33,000
,, Australia	33,000	29,000	— 4,000
,, Germany	27,000	24,000	— 3,000
,, United States ...	39,000	71,000	+ 32,000
,, Belgium	7,000	5,000	— 2,000
,, Other countries ...	17,000	39,000	+ 22,000
Total	397,000	475,000	+ 78,000
Steam engines.—			
From United Kingdom ...	29,000	8,000	— 21,000
Gas and oil engines (except for motor-cars).—			
From United Kingdom ...	149,000	160,000	+ 11,000
,, Australia	6,000	4,000	— 2,000
,, United States ...	22,000	24,000	+ 2,000
,, Other countries ...	3,000	2,000	— 1,000
Total	180,000	190,000	+ 10,000
Boilers.—			
From United Kingdom ...	6,000	10,000	+ 4,000
Other machinery (except agricultural, printing, sewing, textile, etc.).—			
From United Kingdom ...	76,000	77,000	+ 1,000
,, Australia	9,000	8,000	— 1,000
,, Germany	3,000	6,000	+ 3,000
,, United States ...	20,000	22,000	+ 2,000
,, Other countries ...	6,000	5,000	— 1,000
Total	114,000	118,000	+ 4,000
Mining machinery.—			
From United Kingdom ...	13,000	15,000	+ 2,000
,, Australia	5,000	7,000	+ 2,000
,, Germany	1,000	—	— 1,000
,, United States ...	7,000	4,000	— 3,000
Total	26,000	26,000	— —
Meters: Water, gas and electricity.—			
From United Kingdom ...	27,000	33,000	+ 6,000
,, Australia	1,000	2,000	+ 1,000
,, United States ...	2,000	2,000	—
Total	30,000	37,000	+ 7,000
Railway and tramway plant.—			
From United Kingdom ...	38,000	67,000	+ 29,000
,, Australia	2,000	2,000	—
,, Other countries ...	5,000	2,000	— 3,000
Total	45,000	71,000	+ 26,000
Lamps and lanterns.—			
From United Kingdom ...	35,000	36,000	+ 1,000
,, Germany	15,000	12,000	— 3,000
,, United States ...	15,000	14,000	— 1,000
,, Other countries ...	7,000	2,000	— 5,000
Total	72,000	64,000	— 8,000

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Garage Heating.

As the problem of garage heating should surely be served by electricity, it would be very interesting to hear the views of other readers of the ELECTRICAL REVIEW.

As a contractor, I have been asked from time to time by many customers to make suggestions for heating their private garages, in some cases not only with a view to keeping the circulating water of the motor-car from freezing during the frosty periods of the year, but to prevent damage to upholstery, &c., from dampness, and I have had considerable difficulty in supplying their wants.

Manufacturers' knowledge on the matter seems to be very limited. Some have suggested luminous and radiant heating; others have even sent us on approval convectors running at red heat, wired with ordinary flexible wire, and without provision for earthing, ignoring our carefully-worded inquiries calling for suitable apparatus that would be safe to use where petrol vapour might be present and the danger from shock.

I find it impossible to get any data on the subject, although I found one firm who illustrated a "Garage Heater," which I was assured "would be quite satisfactory," but upon receipt found the elements glowed when in use. When complaining, I was told that I viewed the matter too seriously, suggesting that almost any electric stove would be quite safe to use.

Now, if the latter is the case, I should be only too pleased to stand corrected, but as I am confident that there is a demand for an inexpensive, economical and *safe* electric heater, if only to protect the cylinders of cars when garaged against damage from frost, I think that some account of others' experiences would be interesting to manufacturers, contractors and supply engineers, as also to car-owners themselves. Perhaps some of your readers would oblige by replying.

Interested Inquirer.

[We believe there is no danger in using glowers at a dull red heat (1,300° F.); the ignition temperature of petrol vapour in air is about 2,200° F., or bright orange. Certain slow-combustion stoves are commonly used in garages, so low-temperature electric radiators should be quite satisfactory.—EDS. ELEC. REV.]

From the Fleet.

On behalf of the electrical staff, I wish you and yours a Happy and Prosperous New Year.

I shall look forward with much appreciation to the ELECTRICAL REVIEW, which, thanks to your kindness, I now receive regularly each Saturday.

H. Christie, *Electrician.*

H.M.S. *Bonaventure*, c/o G.P.O.,
December 29th, 1914.

German Agencies.

It seems hopeless to induce the Electrical Co., Ltd., to reply to any attacks that may be made upon them, and this more than ever convinces me that they have received their orders from Berlin in the first place as to what to do, and it is perfectly plain that they have been told to lie low and say nothing, and consider themselves an English firm until such time when they can blossom out again. In the meantime, the "foolish" Englishman will keep on supporting them and provide profits to be sent to Berlin later on.

It would be interesting to know how many British contractors are foolish enough to purchase from firms like these, the head of which, as has already been stated, being one of the Kaiser's right-hand men in all his scheme of devilry. I should be glad if someone would consider the question of forming a league to advertise all firms like this throughout the whole of the British Empire, there being in addition to the Electrical Co. a large number of others posing as British which are absolutely German from beginning to end. It would certainly be worth while to take good care that the general public know about it.

I heard lately that the E ectrical Co. still have the audacity to call upon people and pose as a British firm offering to sell British-made goods, but it is apparent, I again repeat, that they have had their orders what to do.

One particular firm, the proprietor of which has an intense hatred for everything German, absolutely declined to believe me, until I showed him the list of the shareholders of this company, and he based his opinion on the fact that they were offering to sell him nothing but British-made goods—and for a very good reason, I should imagine, as, seeing our Navy has tightened things up so much, it would be hopeless for the Germans to attempt to get anything out of their country, as it takes them all their time, with all their trickery and dodges, to get anything into it.

I should be obliged if someone in the different towns where this firm has branches would take this matter up to the point of directly insulting them to a certain extent, which might bring the matter to a head, as, so far as I can gather, in all the towns where their branches are situated they are still carrying on business as if nothing had happened, and just as if we were carrying on war with properly civilised people, whereas, from the records of the war so far, we are carrying on war with the foulest savages.

Contractor.

Advertising and Character.

As one whose business is concerned with engineers' advertising, I can concur wholeheartedly with the views expressed by you in your present issue, and with those of "Consultant."

An advertisement does, or should, reflect the character of the firm issuing the announcement. Humour has a place in advertising, though not in technical advertising. A funny cartoon may attract attention, but the chances are that it will not influence business. An advertisement of this nature may interest and amuse the reader, but the point is, will it impress him with the quality of the goods advertised; will it create a bias in favour of the specialities put forth? After all, readers of technical journals are engaged in serious work, during business hours; it is when the work is over for the day that they seek mental relaxation. Humour only appeals to a man when he is in the mood for it, and most of us are not in the right frame of mind to be amused when business calls for our whole attention.

A reader of a technical publication picks up his journal for information on his particular branch of trade. Well, if you are an advertiser, give him what he wants—data about your goods—and present this information as attractively as you can. Your object is to make your advertisement stand out from the pages of the paper in which it appears; stand out distinctively so that it will attract, and create a favourable impression. Now an ugly advertisement may secure attention, but it will never cause a feeling of pleasure to arise in the mind of the reader. The four functions of any advertising announcement are: To attract attention; to create interest sufficiently strong to induce the reader to read the message put before him; to give a bias in favour of the advertised article; to get him to act, either by calling on the advertiser, by writing for a booklet or for information, or to purchase outright. The latter depends on conditions, necessarily.

Many advertisers do not realise the value of plenty of white space. Wide margins will give an advertisement dignity and prominence, and do away with any impression of overcrowding. A comparison of the advertising pages will prove this. Let the reader try this in one of his own advertisements and he will appreciate the improvement.

Another failing with some firms is to use blocks of their machines which are too large for the space they occupy. This makes the announcement look overcrowded and heavy, and furthermore, leaves very little room for the message.

In many instances it is a good plan to show the application of the goods offered. The value of pictorial representation cannot be over-estimated. A picture tells the story at a glance; but it must be appropriate. For instance, it is better to show an electric fan at work in a smoke-room, dispelling tobacco fumes, than to use just a plain cut of a fan standing idle. The first has life—"imagination"; the second is dull, uninspiring. But as I have said earlier, illustrations must be used with care and judgment.

And the same degree of care should be exercised in writing the "copy," that is, the text. Information should be tendered pleasingly but forcibly; just enough data to interest the reader but not enough to satisfy him. The appetite wants to be whetted. You want him to write for more. Once he is in touch with you, the advertisement has done its work.

One final word. Let the advertiser select his list of papers with the same care which he uses in choosing his travellers. Having decided on his media let him stick to them, and not change from one to another every few months. The most successful advertisers are consistent advertisers. To keep changing from paper to paper means losing the cumulative effect. Very few salesmen call on a firm and get an order at the first visit; they keep calling on the best firms, in many cases for months and months before they open the account. In the same way your "silent salesmen," your advertisements, must convey their message at regular intervals.

If any reader who is not satisfied with the results from his expenditure will only apply the suggestions I have made to his own case, I am sure he will experience greater success than he has obtained in the past, as these remarks are engendered by a close acquaintance with the subject under discussion.

Ernest Ingram Hill.

Wimbledon, S.W., *January 1st*, 1915.

The letter from "Consultant," and your editorial thereon, remind me of a conversation which I had with a man in the petrol-motor trade about reorganising several departments, and who, when it came to publicity expenses, emphasised a statement to the effect that his firm spent a lot on advertisement. "Pardon me," I said, "Your firm buy a good deal of space, but they never advertise." He was astonished, and could not grasp the difference for several minutes.

The above is the case with some 95 per cent. of the advertisers in this country in all trades. A very high percentage of the space taken is taken simply because it is usual to "advertise," and almost everyone else does it. Further, whoever is responsible for engaging an advertising manager or his staff, seldom has any knowledge of publicity work, and simply resorts to catch-phrases, such as "pulling copy," and the like, while the very meaning of "pulling copy" is unknown to the interrogator. Again, directors and managing directors seldom actually know what an advertisement is, and mistaking somewhat fluent space-filling for the genuine accomplishment, a highly efficient advertising man is not always engaged, as a man who can talk intelligently about his subject cannot make any more impression on another who does not understand it, so that the writer of hackneyed common-places stands as much chance of being engaged—perhaps more, because he will be cheap. One of the results is that we get space very often filled with "dead" and very usual matter, while blocks suggest a trial set suspended in space or a vehicle stranded outside the works without a sign of "life" in sight. One could, of course, write at great length in dealing fully with all the advertising ramifications of any special trade, but, speaking generally, matter in periodical advertisements should emphasise a leading line each week, or as often as the publication appears, with all the remaining or principal lines in rather smaller type, conveniently placed for reference. Illustrations should preferably show installations, and blocks should not be so highly finished or photographs so re-drawn as to produce a terribly wooden effect, which often has a particularly unfavourable result on overseas business. There is a whole budget of other practical advertising suggestions going for any firm who will begin to realise that mere space-filling is one of the most unproductive of expenses.

If any firm could see their way to standardise and advertise prices for different-sized D.C. and A.C. motors they would touch a remunerative line. I believe, however, that as the prices of these machines vary so much with the circumstances, competition, &c., under which they are sold, it would be difficult to give publicity to figures. Such prices, however, would have to be from 12 to 15 per cent. below the official figures, which were thought to be high at one time.

Arthur Mallord Turner.

London, S.W., *January 4th*, 1915.

Alluding to your "critique" entitled "Advertisement and Character," one has but to move down a main street, to turn the leaves of a periodical, or to watch the speeding countryside from a flying track, to behold "Advertisement" tragic in its endeavour to appeal—humorous, in its analogy to the burdened washing line of Poverty's back yard.

The line is a necessity, so also is advertisement, but whereas we shun gazing at the one, alas for natural instinct, we are the puppets of a moving show on the other.

If only advertisers would realise that their productive effort is for the *uninitiated*, and that the sure way to appeal to ignorance is by suggestion—knowledge gilded with subtle flattery—colour yells would cease to deafen, and the public, treated more as a sane community than a kindergarten, would be less liable to seek the haven offered by "the rainy day" theory.

A few well chosen lines leading up to the main scheme instead of an opaque mass of monochrome or futurist nightmare of colour, and, again, a gradatory form of lighting advertisement for night work, would go far to procuring business and helping the trade. The elusive advertisement of a necessity lives longer than the one that strikes a solitary note and then is silent.

Trusting that the raising of the question will bring the matter the notice it deserves.

Rex. C. Andersen.

London, W., *January 4th*, 1915.

A.C. v. D.C. for Lighting.

I am planning the illumination of a number of machine shops at present lighted by gas, by means of several thousand drawn-wire and half-watt lamps.

Two electric supplies are available—D.C. at 240 volts, and A.C. 110 volts 40 cycles.

As the class of work done in these shops is of very close nature and demands much local lighting, the low-voltage A.C. would be most suitable, but it has been suggested that A.C. lighting is more trying to the eyes, and that trouble may be experienced by the lights getting into synchronism with the moving machinery.

Personally, I should think the heat capacity of the filaments would prevent this, but perhaps some of my fellow-readers of the ELECTRICAL REVIEW who have had experience with A.C. lighting under similar circumstances will be kind enough to give their views upon the matter.

Ex-Gas.

January 2nd, 1915.

WAR ITEMS.

Divisional Engineers—Royal Naval Division.—The Institution of Electrical Engineers is informed that it has been decided to form another Field Company of Engineers for the Royal Naval Division. It is desired that at least two sections of the new company should consist of highly-trained men, and applications are accordingly invited from members of the Institution between the ages of 19 and 35. It is understood that the rates of pay and the duties are the same as those of the Royal Engineers. Applications should be addressed to Captain Harrison, Adjutant, Divisional Engineers, R.N.D., 2, The Downs, Dover Road, Walmer. It will be remembered that the Engineer units of the Division consist largely of members of the Institutions of Civil, Electrical and Mechanical Engineers. Nearly 100 of those who joined these units since they were formed last September have received commissions in the Army.

Post Office Engineering Volunteer Training Corps.—Although some 20,000 postal employés have joined the Colours, this number falls far short of the total number that would gladly enlist; but the necessity of maintaining the efficiency of the service, especially in the telegraph and telephone departments, compelled the authorities to retain the men in their customary occupations. There are in all nearly 50,000 men in the service of the Post Office in London, of whom over 7,000 belong to the Engineering and Stores Departments, and when it was proposed to form an Engineering Corps, to train the men who were not allowed to enlist, the response was enthusiastic. A commencement was made with 600 men, though fully double this number applied for enrolment, and the corps was duly formed three weeks ago. The Commandant is Mr. H. C. Gunton, principal power engineer to the Post Office and engineering adviser to the Central Association of Volunteer Training Corps; the Acting Adjutant is Mr. G. F. Preston, Controller, London Telephone Service, and the Second Commandants are Messrs. A. J. Stubbs and W. Noble, Assistant Engineers-in-Chief, and A. Moir and J. M. G. Trezise, Superintending Engineers, London District. The Quartermaster is Mr. A. Parsons, Controller of the Stores Department, and the Company Commanders are Messrs. D. H. Kennedy, Assistant Superintending Engineer, London; A. Watts, Staff Engineer, Engineer-in-Chief's Office; G. F. Greenham, Assistant Superintending Engineer, London; and L. B. Turner, Assistant Staff Engineer, Engineer-in-Chief's Office. Drills take place in the evenings at the Inns of Court Hotel, which has been acquired by the Post Office for a future telephone exchange, and a programme of field work for Saturdays and Sundays has been arranged. The A, B, and C companies are designated as air-line companies, and will erect temporary telegraph and telephone lines and stations in the field; D company is known as a field company, and will deal with permanent line construction and the heavier branches of engineering field work generally. The first Corps parade took place on Saturday last in the yard of the King Edward VII Building, and was followed by a route march of 5½ miles.

The Volunteer Training movement has quickly overspread the whole country, and at least a million men are said to be training diligently in their spare time; but few corps are likely to make a better showing than the new P.O. Engineering Corps, which is recruited from an exceptionally fine body of men, very many of whom have been through the mill already.

Board of Trade Electrical Exhibition: Open To-day.—The Board of Trade Commercial Intelligence Department invites British electrical manufacturers and representatives of wholesale houses who have previously imported electrical accessories from Germany and Austria-Hungary to attend the exhibition of such goods that they have organised. The exhibition was opened yesterday at 32, Cheapside, E.C., and it continues open to-day, and various samples of German and Austro-Hungarian goods are on view. Many of these, no doubt, our firms have already come up against in the ordinary course of business, but the collection, as a whole, if anything like representative or complete, should be instructive.

German Methods in Australia.—A short time ago, in commenting upon methods of German electrical firms, Mr. Harper, city electrical engineer, Melbourne, stated (says the *Melbourne Age*) that it was often very difficult to perceive the German connections of many firms. Many German firms, like the Allgemeine Electricitäts Gesellschaft, had their headquarters in Melbourne, and traded under all sorts of local names. The practice of removing name plates and manufacturers' marks was, he believed, a common one, and was being indulged in pretty freely at the present time. He was quite certain that England could supply the Colonies with every type and quality of electrical appliance required, and believed that Australia was, in fact, one of England's best customers in electrical goods.

In the course of an article on the "Duty of Australians," published in October, the *Australian Mining Standard*, which has ever since the outbreak of war made a weekly feature of a forceful anti-German campaign, made the following observations on the methods of German traders:—

"How thoroughly the Germans prepared for this war has been shown in many ways, and it is also becoming increasingly clear to what an extent their business men trading or having agencies in Australia were aware that this war was coming. . . . It is significant as showing how thoroughly ostensibly peaceable firms knew what was coming, that many German accounts with Australia were, *for the first time*, allowed to fall into arrears towards the close of the first half of this year. Can we then trust a people such as this? Indeed, do we not know them to be a contract-breaking people, whose signature to 'a scrap of paper' is of no sanctity whatever? If we cannot trust them, have we any justification for continuing to deal with them? No, it is our duty, both on moral grounds and on grounds of policy, to have nothing whatever to do with a race so treacherous. Let it be added further, that, now we are thoroughly acquainted—but no, that is too much to say: let it be altered to 'now we are to some slight extent acquainted'—with the dubious and underhand methods employed by German firms for the furtherance of business in Australia and elsewhere, we will say deliberately and unhesitatingly that any municipality, any Government, any public concern whatever, accepting a contract from any firm representing German interests, will lay itself open to a very grave suspicion of having had its honour tampered with. It is notorious that some of the German firms trading in Australia set aside sums of money for use by their agents for purposes of bribery. Let it be made quite clear then that anybody, when this war is over, accepting the contracts of such firms, will be open to the suspicion of having been induced in this way to consent to the placing of a contract with a nation which has shown itself to be the deadly enemy of the Empire to which we belong."

Haslingden Corporation Contracts.—A long discussion took place at a recent meeting of the Haslingden Corporation Electricity Committee upon the question of trading with Messrs. Siemens Bros. & Co., Ltd., and Mr. Snow-Huddleston and Mr. Hill, representatives of the firm mentioned, appeared before the Committee and explained the position and composition of the company. Eventually a resolution was moved to the effect that when tenders are required in future for electrical cables and goods, Messrs. Siemens Bros. & Co., Ltd., should be allowed to compete as heretofore. An amendment was brought forward that when existing contracts with the firm were completed the Corporation should cease trading with the firm, and 10 voted for the amendment and 13 against. The amendment, therefore, was lost, and the original resolution was subsequently adopted.

A Copper Famine.—According to a report from Switzerland, Germany is so sorely in need of copper that telegraph and telephone wires are being pulled down, at first in the less populous districts, and electric light cables will also be utilised to supply the need. The great gates of Antwerp Railway Station have been commandeered. According to the *Times* Brussels correspondent, the German authorities are requisitioning copper articles in all parts of Belgium. Copper saucepans, crucifixes, and holy water basins are being taken, and from a Brussels factory copper to the value of £12,000 has been requisitioned.

Sydney Council Contracts.—When the Sydney City Council had before it toward the end of October a recommendation of Mr. Forbes Mackay, the city electrical engineer, that three transformers be obtained from the U.S.A., at a cost of £5,097 (an English firm had tendered £1,000 less), it was explained that the American firm had guaranteed delivery within 13 weeks, and that the type offered by the British firm was not what the engineer wanted. As a result of the discussion in the Council (according to a report in the *Sydney Morning Herald*) it was decided that fresh tenders be called, confined to articles of English manufacture. The principal speaker in the discussion said that he believed in distributing a wage fund within the Empire in this supreme crisis, and not in sending their money to foreigners.

"One Clear Call."—This is the title of a pamphlet by Mr. A. H. Ashton, founder of the Voluntary Recruiting League, of which the latter has printed 100,000 copies for general distribution, with the object of stimulating the enlistment of recruits throughout the British Isles. The published price is 1d., and copies can be obtained from the League at Empire House, Piccadilly, W. A selection of the opinions of eminent readers shows that the pamphlet has made an excellent impression on them, and is regarded as a valuable aid to recruiting. The author recapitulates the events which led to the outbreak of the war, and makes an effective appeal to the reader to enlist in the new Army, if he is eligible. All profits made from the sale of the pamphlet will be devoted to the furtherance of recruiting.

Burnley Tramwaymen.—The War Office has expressed a desire that ex-non-commissioned officers on the staff of Burnley electrical tramways department should join the Army as instructors. Up to the present, 148 men have joined the ranks from the tramway staff.

Royal Flying Corps.—According to the *Manchester Courier*, the Royal Flying Corps military wing are calling for the following and other tradesmen :—Acetylene welder, æroplane mechanic, cable jointer, coppersmith, draughtsman (mechanical), electrician, fitter, instrument repairer, metal turner, pattern maker, wireless operator, driller, dynamo attendant, electric-bell fitter, machinist, motor fitter, switchboard attendant, tool grinder, wireman.

E.T.U. Men with the Forces.—In an article in the *Herald* on the policy of the Electrical Trade Union, the author, J. Kinniburgh, says that the membership is 8,000, of whom 10 per cent. are "fighting for *our* king and *their* country"; another large number are building warships, leaving "about 2 per cent., if that, out of employment."

Personal.—Mr. E. B. C. Preston, manager of Messrs. Siemens Bros. Dynamo Works, Ltd., Rangoon, has been appointed a 2nd Lieut. in the Indian Army Reserve of Officers. He has been attached to the 32nd Sikh Pioneers at Sialkot, Punjab, and left Rangoon on December 13th for that place.

Owing to their not being allowed to enlist in the Forces for active service on account of the exigencies of the work of the department, the names of the following members of the electricity staff at Woolwich have been recorded in the minutes by the T.C. :—Mr. W. B. Wadie, assistant engineer; Mr. Walter Scott, acting charge engineer; Mr. J. Rhodes, stoker; and Mr. G. R Smith, clerk.

Mr. Leonard J. Aron is in France serving as Corporal in the Army Service Corps, "Mechanical Transport," British Expeditionary Force.

Private Wm. Lonsdale, who was condemned to death for an assault at the Doberitz Concentration Camp, Berlin, but whose sentence is said to have now been commuted to one of ten years' penal servitude, is a Leeds man, who was a reservist in the 2nd Battalion West Riding Regiment. He was called up from his employment as a tram conductor in Leeds at the outbreak of the war, and took part in the battle of Mons, where he was wounded and taken prisoner on August 24th.

Mr. Francis B. Shaw, A.M.Inst.C.E., A.M.I.E.E., electrical engineer to the Government of Siam, who recently contributed to our pages an interesting account of the Siam Electricity Works, has joined the R.N.V.R. armoured car division as Lieutenant, and hopes soon to be on active service.

The Manchester Tramways Committee has passed a resolution expressing appreciation of the excellent work done by Mr. J. M. McElroy (general manager) and the whole of his staff in connection with the war crisis.

In the list of certificates of naturalisation appearing in the *London Gazette* on January 5th, the following entry appears :—Gerald Henry John Hooghwinkel (Netherlands), consulting engineer, 95, Linden Gardens, Bayswater, London. Date of oath of allegiance, December 10th, 1914.

Roll of Honour.—Private Matthew Partington, of the 3rd Loyal North Lancashire Regiment, an employé at the Preston electricity works, has been killed by a bomb dropped from a German aeroplane.

Private Thomas Turner, of Dukinfield, who was employed as a driller at the generating station on Tame Valley, has been wounded whilst serving with the 1st Shropshire Light Infantry.

Lance-Corporal Ernest Mann, a motorman on the Manchester tramways, has received an official intimation that he is to be recommended for distinction for conspicuous bravery in the field.

Sergt. William E. Sayle, of Bispham, a driver on the Blackpool and Fleetwood tramcars, has been killed in action whilst serving in the Scots Guards.

REVIEWS.

Test Questions in Wireless Telegraphy. Series 1 and 2.—The Students' Library. London: The Wireless Press. Price 1/- each set.

These test questions are published in the form of a series of cards, 38 in Series 1 and 48 in Series 2. They are intended for students who are beginning to take up "wireless" as a profession, as well as for amateur wireless experimenters, and they provide a convenient means of testing knowledge.

Series 1.—This series of 38 cards comprises 228 questions, roughly graduated from the very elementary principles of magnetism, electrostatics and current electricity up to questions involving considerable technical knowledge of wireless operations. In places the graduation is very rough, and in the cards numbered 1 to 10 there is needless repetition and very little method in the choice of questions; card 11 on the induction coil and the series of cards on waves show a much less random selection. The questions on the technical part of the work are certainly calculated to search out the weak points of the student who sets himself to work conscientiously through them, but even here a certain reckless mixing of easy and difficult questions is to be regretted.

The cause of the trouble is probably to be found in the suggestion that the student "can either choose a card at random, taking a new card each day, or he can work steadily through the set in numerical order." It is fairly obvious that one set of cards can scarcely hope to serve both purposes—the "random selection" method demands quite a different arrangement of questions from the "work through in order" method, and where the cards fail is in the attempt to fulfil these two conditions simultaneously.

Series 2.—This series of 48 cards comprises 288 questions, covering the whole of the ground in the theoretical section of the P.M.G.'s examination. The questions dealing with electricity and magnetism are based on the ordinary text-books, those which deal with wireless telegraphy on Hawkhead's Handbook of Technical Instruction for Wireless Students and those concerned with regulations on the P.M.G.'s Handbook.

The failing noticed in Series 1 is conspicuous by its absence in Series 2, the questions being graduated with obvious care. This series is, indeed, admirable in every way, and the first 20 cards could be worked through with advantage by any student of applied electricity, while to the students of wireless the whole set should prove an invaluable aid to a mastery of both the theoretical and practical sides of his subject.—P.H.S.K.

Anleitung zum Bau Elektrischer Haustelegraphen Telephon Kontrol und Blitzableiter Anlagen. Berlin: Aktiengesellschaft Mix and Genest. 7th Edition.

This book, which was first published in 1890 and has now reached its seventh edition, occupies a position in the literature of weak-current installations somewhere between the ordinary maker's catalogue and the scientific text-book, though much nearer the latter than the former. Although it is published under the auspices of one of the large makers in this branch of the industry, and is illustrated by means of their own particular make of apparatus, the method of treatment distinguishes it entirely from the mere trade catalogue. It contains a clear and orderly account not only of the apparatus itself but of the principles underlying its construction and of the applications for which it is suitable.

It is, in fact, just the kind of book that the user, or intending user, with little technical knowledge would wish to have at hand as a guide to what can and cannot be accomplished by electricity in the house, office or works, in certain directions.

The contents deal with domestic bells and telephones, telephone exchanges, special types of telephone, mine signalling, sources of energy, line erection, and lightning conductors.

Electric Wiremen's Work. By J. H. HAVELOCK. 1914. London: Crosby, Lockwood & Son. Price 5/- net.

It is to be feared that Mr. Havelock lacks a due sense of proportion—at any rate as regards the relative importance of different sections of a wireman's work. For example, he devotes a large proportion of the first section of the book to the working out in every detail of a series of simple calculations, many of them by logarithms to 4 decimals, when a brief statement of the equation and the answer (which most people would work out on a slide rule) would have sufficed. Again, he wastes some 40 pages in reprinting I.E.E. rules and similar matter which one can obtain free from any insurance company.

The result of this is to fill up the book with a large amount of comparatively valueless material,

whilst many important subjects are scarcely treated at all. The whole subject of wiring in every kind of building, for example, (except mills and factories, which get an extra page), is dismissed in one-and-a-half pages, with another three pages of diagrams of but little real value. Again, there are nearly twenty pages of "problems" reprinted from old examination papers, but no diagram of any inter-communication system of telephones—one of the commonest requirements of the wireman.

Such a subject as the best method of wiring to suit various conditions is ignored entirely, as is also that problem, the answering of which is so important to the contractor, viz., which is the cheapest way to run wires between various lights, switches, etc., with due regard to economy of material and labour?

Whilst these defects are very apparent, there is much in the book which is of value. The chapters on practical work are the most useful, and the suggestion that every wireman should be able to diagram out a wiring problem and make sketches of his work is excellent. The statement that "all sketches should be neatly dimensioned" would have been more pointed if it were not for the fact that out of the seven sketches that are reproduced as illustrations four are without dimensions!

Mr. Havelock has made a framework on which a useful book could be built, but there must be a good many omissions and additions and a number of corrections to the present matter before the book attains to its best value.

Light, Radiation, and Illumination. By PAUL HÖGNER; translated by Justus Eck. London: *Electrician* Printing and Publishing Co. Price 6/- net.

It would have been better, we think, if this book had been published primarily as a mathematical treatise, for looking at it from a practical point of view we have to confess ourselves very disappointed. The preface announces that it is "intended to assist electrical engineers, architects, and others in planning lighting installations, with special reference to arc lighting." The last paragraph, however, points out that "an exact mathematical solution is not always possible . . . as so many causes influence the result in uncertain ways," etc., etc. Although this may be read in the preface we find in the text abstruse calculations which are carried to a very fine point. It should be a comparatively easy matter to amend the formulæ given so that they could quickly be applied and understood by those whose mathematical knowledge is only elementary, and yet be sufficiently correct for all practical purposes.

The first chapter deals with light emission from surfaces, and the formulæ are given in such a manner that many prospective readers would put the book down at once; in fact, it is assumed that one is thoroughly acquainted with the rules and laws relating to the subject. Light emission from bodies is next dealt with, and generally speaking all the steps in the calculations are clearly shown, but unfortunately we begin to stumble over some of the many mistakes which the volume contains. Too much is taken for granted, as for example on page 9, $I = \frac{1}{8} d^2 \times \pi \times h\,(1 + \cos a)$ is said to be "easily seen"; similar "obvious" statements occur throughout the book, and are not conducive to its being well understood.

Having considered matter relating to the above headings we arrive at the real object of the work and learn of the light emission from arc lamps. This subject is well treated from all points of view, and the author is very frank regarding the lack of reliability of that type of unit. Many interesting and useful facts regarding illumination are closely dealt with.

Again somewhat cryptic references are made, and it is unfortunate that nearly all the elaborate tables given contain a multitude of figures which compare a 10-ampere old type of arc lamp with a modern 12-ampere proprietary flame arc, so that they can be of but little service. The pages following may possibly be useful to some engineers, but we very much doubt whether the matter put forward will appeal to any but those who have a large amount of time on their hands. We have very carefully studied the formulæ and tables, and as yet fail to realise their practical importance save for those particular lamps for which they are worked out; conclusions may be drawn which are entirely erroneous, especially since full details of conditions are not given. This is particularly the case with table XXV, and we think that the author could be, with advantage, more explicit; also many illuminating engineers will disagree with the statements put forward, for the arguments savour of considerable bias. The figures in table XXVI, which state the minimum requisite illumination, are in many cases very similar to American figures, and are abnormally high when compared with English practice. The writer fails to point out that the sizes of the units with which he deals are somewhat prescribed. In example 2, on page 48, there is apparently one of the frequent omissions which the book contains.

Unidirectional illumination is next considered, and again one finds remarks which are seemingly contradictory; careful study will, however, disclose the fact that the punctuation of the fourth paragraph of section 35 is incorrect; nevertheless the matter itself is of exceptional interest.

The book concludes with a section entirely devoted to calculation methods; these are full of novel features but of doubtful service, for although curves and tables are worked out in a most elaborate manner, the context itself leaves much to be desired in the way of explanation, and we are of the opinion that in the stress of modern business it is almost impossible for the engineer to prepare the necessary data for every type of unit which might be used; the methods given are ingenious but laborious.

As previously stated, this work contains much for those wishing to study the subject treated from an academic point of view. It is to be regretted that the author has confined his attention to certain units; had he generalised his examples and tables the book would have been of greater service. We would also suggest that more care might have been taken in the proof-reading, since errors and seeming contradictions abound, so that the book is scarcely of the standard usually attained in the admirable series published by our contemporary.

BUSINESS NOTES.

Consular Notes.—SPAIN.—The United States Consul at Seville says :—**There is a special call at this time for electrical machinery. The Consulate already has received inquiries from firms desirous of importing electrical motors, &c., but the smaller lines of supplies, fixtures, &c., will probably be furnished, as heretofore, by a German firm that has a factory for this class of goods in Barcelona. There are several well-equipped electrical goods stores in Seville, and people of the better class are taking to the use of fans, irons, water-heaters, foot-warmers, and kindred articles, all of which are shown here. The import duty, however, has been an obstacle to the development of the trade. Electricity is supplied at low rates for industrial purposes, and there is a growing tendency towards a larger use of electrical equipment. Most of the smaller towns and villages are, or are being, equipped with electric light. Catalogues, if they are to be of any use at all must be in the Spanish language and include the quotation of net prices, weights per unit and in quantities, numbers packed in the case, quotations on complete machines, including all accessories, measurements set up and knocked down, and probable cost of packing and shipping. It is scarcely necessary to say that a salesman with the actual goods to show can do more business in an hour than catalogues in a year.**

Trade During 1914.—The MIRRLEES WATSON CO., LTD., **report that their brisk business of the last few years slackened off materially during the first half of 1914, mainly because sugar planters with phenomenally good cane**

crops had to be content with phenomenally low prices for their products. Foreign financial dislocation, through the war, has further depressed matters, preventing some promising schemes from maturing, and hindering the placing of much customary business of a less degree of importance. Shipping difficulties, increase in cost of material, and shortage of labour, have accentuated that trouble, particularly as regards the latter, no fewer than 77 men from the offices and workshops having left to join the Territorials and Regulars. Notwithstanding all this, a fair amount of work has been undertaken, and prospects for the coming year seem good. Apart from the sugar-making and general machinery departments of the business, it may be mentioned that the condensing department has been kept employed throughout. Amongst the larger sizes of installations is one for the Leeds Corporation electricity works, the surface condenser in this case having 46,000 sq. ft. cooling surface—probably the largest surface condenser in existence. A very large number of rotary air pumps of "Mirrlees-Leblanc" type have been supplied, including several for the Maritime Service, and we understand that the working results have been very satisfactory. A steam "Multijector" air pump on a new principle is now being made for marine purposes.

The *Chamber of Commerce Journal* for January contains that journal's usual annual trade review—if anything can be called usual relating to last year. It comprises 60 pages of matter written by experts in leading trades and industries, and reports from special correspondents in all Home, commercial and industrial centres. In the editorial, of which an advance proof has been sent to us, the writer takes a very hopeful view of the outlook, confirming the opinion of the Chancellor of the Exchequer that after the war there will be some four or five years of prosperity for British industries. On the question of the capture of German trade, the writer expresses the opinion already voiced in our own pages, that it is for the Government and commercial men alike to carefully study the possibilities of Germany unloading stocks of goods here at below cost price after the war, and to devise means for dealing with this problem, which will be so urgent and difficult in the near future.

Calendars and Diaries.—MESSRS. NALDER BROS. AND THOMPSON, LTD., of 97A, Dalston Lane, London, N.E., have sent us one of their wall calendars with monthly sheets for 1915; it is of the usual size and in the familiar style.

From MESSRS. THERMIT, LTD., of 27, Martin's Lane, London, E.C., we have received, as in previous years, a pocket note-book, with calendars for 1915 and 1916. The opening 36 pages contain illustrated material concerning the Thermit process and some general information.

MESSRS. STEWART & LLOYDS, LTD., of Winchester House, E.C., adhere to the same form and appearance as in previous years for their wall or desk calendar for 1915; monthly cards are fitted in a white frame bearing a gilt monogram, the whole forming one of the neatest of the New Year souvenirs that reach us.

THE VICTA ELECTRICAL CO., of 60, Queen's Road, Battersea, S.W., have issued a wall calendar for 1915, with monthly slips.

From MESSRS. W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., Blomfield Street, London Wall, E.C., we have received a wall calendar with weekly slips. The words 1837 and 1915, placed on either side of a view of the Tower of London, remind us that the business is one of the oldest established in the industry, while the excellence of the calendar shows that the firm knows how to do a thing well in 1915.

A calendar with monthly sheets has been received from the NAVY EMPLOYMENT AGENCY, of 25, Victoria Street, S.W., where from among men who have served in the Royal Navy or Royal Marines, engineers, artificers, electricians, mechanics and other workmen, can be engaged.

MESSRS. BRECKNELL, MUNRO & ROGERS, LTD., of Thrissell Street, Bristol, have prepared a wall calendar with neat and small monthly date slips below a view of London. An impressive panoramic view executed in effective colouring embraces both sides of the Thames, as seen looking up the river from the Tower Bridge, bringing within its compass the many buildings and other features typical of metropolitan and national greatness coming between the Tower of London on the one hand, and the Houses of Parliament on the other. With feelings of pride, one is reminded of Blucher's celebrated remark, "What a city to sack!"

THE WESTINGHOUSE BRAKE CO., LTD., of 82, York Road, King's Cross, N., have issued a calendar for 1915. Monthly tear-off sheets each bear a half-tone illustration of an application of the Westinghouse-Morse silent rocker-joint chain drive.

DAVENPORT ENGINEERING CO., Bradford.—A calendar for 1915 has been issued by the firm. The card depicts some of the firm's cooling towers and a block of daily date slips with clear figuring is attached.

MR. CHARLES H. BLUME, of Fitzalan Square, Sheffield, is sending out two good rules to his friends, one is of 5 in. in length and can be used as a letter opener; the other is, of course, to use "Megomac" and "Insulac" varnishes.

MESSRS. GILLESPIE & BEALES, of Amberley House, Norfolk Street, Strand, W.C., have issued a war calendar which is bound to be a favourite. Its strongly patriotic note and the unobtrusive manner of printing of the firm's name will ensure for it a place on our own walls, and we can give no better testimony. The design includes the flags of the Allies, the heads of their respective nations, and our military and naval leaders in the struggle. The importance of our naval and aerial fleets is fully taken into account pictorially.

THE BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, has prepared a large hanging calendar, with a sheet for every month of 1915. The calendar differs, as usual, from all others received at this office, by reason of the fact that each sheet includes the preceding and following month in addition to the current one. Each sheet contains a bird's-eye view of the Rugby Works and an illustration of one or other of the firm's manufactures.

THE VARLEY MAGNET CO., LTD., of Woolwich, have issued a serviceable wall calendar for 1915, with monthly tear-off sheets.

From MESSRS MAWDSLEYS, LTD., of Zone Works, Dursley, we have received a wall calendar, with neat little monthly date slips for 1915. In the selection of a subject for the pictorial feature, "Her Favourite Flower," which is executed in colour, the firm have shown the excellent taste that has always marked their choice in such matters.

Bankruptcy Proceedings.—WILLIAM HENRY WOOD, electrical engineer, Lorna Doone, School Lane, Hall Green, Birmingham, Warwick.—The adjourned public examination of this debtor was held at the Court House, Corporation Street, Birmingham, last week, before Mr. Registrar Lowe, when debtor returned his liabilities at £470, and his assets at £1,228, the estate disclosing an apparent surplus of £759. He stated that he did not consider himself to be insolvent, but that owing to the action of a limited company, of which he was managing director, in refusing to pay his salary, and in making an illegal call on shares, he had been forced into such a position that he could not immediately meet his liabilities, but his assets more than covered them. Questioned by the Official Receiver with regard to the assets, debtor said that the book debts were due from the company of whose action he complained, and they were the subject of an action now pending, the company disputing their liability to pay him. Nevertheless he regarded the debts as good, and he should say that if the company had got any money they ought to pay the debts. He admitted that the only tangible asset was a small balance from the furniture. In October, 1912, he acquired the lease of half an acre of land at King's Road, Tyseley, upon which a factory was built, and a limited company was promoted for the purpose of carrying on the business of electrical engineers, and especially for manufacturing machine-made brass work for most trades. He borrowed money to equip the factory. In April, 1913, the company was registered with a nominal capital of £8,000, and altogether about 6,000 shares were subscribed for. He agreed that the concern had a fair amount of working capital, and that there was no reason why it should not have been successful. Friction arose between the directors and debtor, and he was requested to keep away from the works, at any rate for a time. This he protested against through his solicitor. From that time his salary ceased. The complaint against him was that the work was not turned out as it might be, but he pointed out that the offence, whatever it was, was condoned by a subsequent agreement he had with the company on terms which, if the concern had been successful, would have paid him better. This was dated January 9th last, and no further complaints were made. He had received no notice to terminate his services. The examination was closed.

For Sale.—Coventry Electricity Department have for disposal by tender one 600-KW. McLaren-Siemens generating set, particulars of which are given in our advertisement pages.

Electrical Industry in Scotland.—A correspondent writes:—"Electrical firms in Glasgow and the West of Scotland are pressed with orders. The Electric Control, Ltd., have supplied several very large controllers, including four 600-H.P. three-phase controllers for high-pressure hydraulic pumps, each taking 900 amperes to start, and many automatic sets for air compressors in shipyards, of 200 to 350 H.P. The firm are now fulfilling the order for the automatic controllers for what will be the largest electric lifts in the United Kingdom, each lift being operated by 250-H.P. three-phase motors. Messrs. Drysdale & Co., Ltd., Yoker, Glasgow, have provided a large installation of electrically-driven pumping plant for the Port of London Authority for use as impounding pumps. A feature in shipbuilding work is the growing popularity of the 'Hele-Shaw Martineau' electric hydraulic steering gear. At present Messrs. John Hastie & Co., Ltd., are completing four sets for new battleships, and two sets for torpedo-boat destroyers, and also a large number of sets for Diesel motor vessels. A Glasgow firm has orders in hand for plant for Japan, Sumatra, South America and Australia, in addition to all descriptions of electric plant for ordnance and ammunition workshops. The 'Quartowatt' electric heaters have been placed on board many new ships, including various new British India liners, to take the place of steam heating. The West of Scotland firms have a good share of urgent War Office and Admiralty work. An East of Scotland firm, Messrs. Hawthorn & Co., Leith, specialise in electric slipway haulage machinery, and are shipping out a set of 600 tons to Auckland Harbour, also a set of 800 tons capacity for Peru."

Spagnoletti Developments.—In regard to the recent enlargement in the business of Spagnoletti, Ltd. (established 1851), and the change in its title, we learn from the directors that a factory has been erected on an extensive site at Park Royal, London, N.W., and further, that the company will in future by known as the PARK ROYAL ENGINEERING WORKS, LTD. Except for additions, the directors and staff remain unchanged. The factories have been specially designed on up-to-date lines with a view to handling the large switchgear and instrument output manufactured for the Admiralty, War Office, and many Corporations to whom the company are contractors. A history extending over 63 years is a long one in the electrical trade, and so lengthy an experience, combined with well-equipped factories, should go far to ensure a successful career for the new company.

Catalogues and Lists.—BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Price list No. 2,510 describes and gives dimensions of B.T.H. shaft couplings.

MESSRS. SIEMENS BROS. DYNAMO WORKS CO, LTD., Caxton House, Westminster, London, S.W.—The firm have issued a new eight-page printed list of lantern slides that are held in stock at Caxton House for lending free of charge to lecturers, schools, &c. The list has been revised and enlarged, and now consists of 208 different views, covering all classes of electrical machinery and apparatus manufactured by the firm at Stafford and Dalston.

EDISWAN & SWAN UNITED ELECTRIC LIGHT CO., LTD., Ponder's End.—Four picture postcards have been issued, showing the application of Royal Ediswan drawn-wire lamps in different departments of the household. Quantities bearing customers' names, &c., will be supplied on application. The company have also issued correspondence poster stamps as a "Symbol of Electric Service."

GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—New illustrated and priced leaflet (O.S. 1878) of Osram half-watt drawn-wire lamps, 1,000 and 2,000 C.P. Also No. O.S. 1,852, a new four-page list, the front page of which bears the "leading light" coloured poster design (reduced, of course!), the contents being illustrated particulars and prices of various types of Osram lamps with bayonet caps.

MESSRS. J. H. TUCKER & CO., King's Road, Hay Mills, Birmingham.—New folder (No. 1) describing their latest ironclad switch.

DAVENPORT ENGINEERING CO., Bradford.—This publication consists almost entirely of half-tone photographic views of Holehouse's patent natural draught chimney cooling towers as supplied by the company to various electric light and power authorities, collieries, and woollen mills, also line drawings of interiors of the towers.

MESSRS. SIMPLEX CONDUITS, LTD., 116, Charing Cross Road, London, W.C.—Thirty-six page list, giving descriptive information regarding their Plexsim system of electric heating and cooking, and illustrations and prices of a complete range of appliances, including many designs of kettles, irons, hot-plates, &c. Four distinct types of electric ovens are illustrated, and electric urns, large and small water-heaters, hot cupboards, and larger electrically-heated appliances are also shown.

Dissolutions and Liquidations.—SCHLEYDER'S ECONOMIC STEAM FURNACE (CONTINENTAL), LTD.—This company is winding up voluntarily, with Mr. R. W. Ednie, of Craven House, Kingsway, WC., as liquidator. A meeting of creditors was held on January 4th.

FELGATE INSTALLATION CO., LTD.—A meeting of creditors is called for January 11th, at the Reading Gas Co.'s Lecture Hall, by the liquidator, Mr. A. G. West.

ARGENTINE ELECTROLYTIC SYNDICATE, LTD.—A meeting will be held at 17, Albion Street, Hanley, on February 8th, to hear an account of the winding up from the liquidator, Mr. R. E. Clark.

ABBOTT, POPE & CO., builders and electrical engineers, 248, Belsize Road, Kilburn, N.W.—Messrs. J. Abbott and A. Pope have dissolved partnership. Debts will be attended to by Messrs. Abbott & Pope, at 42, Bolton Road, St. John's Wood, N.W.

SPAGNOLETTI, LTD.—In pursuance of Sec. 188 of the Companies' (Consolidation) Act. 1908, a meeting of the creditors will be held at 34 and 36, Gresham Street, London, E.C., on January 19th. The Park Royal Engineering Works, Ltd., purchased the entire issue of debentures in Spagnoletti, Ltd., and the new factory now being completed, the liquidation of Spagnoletti, Ltd., has become necessary. Certain of the assets, in which are included the stock and book debts and work in progress, have been transferred to the Park Royal Co. in full satisfaction of the debentures, the new company at the same time having undertaken to discharge all the existing trade liabilities of Spagnoletti, Ltd. The meeting is a formal one.

Machine-Stoking at Blackpool.—MESSRS. EDWARD BENNIS & CO., LTD., of Little Hulton, Bolton, have installed four of their chain-grate stokers at the Blackpool Corporation electricity works, fitted with the Bennis-Miller-Bennett patent links, the distinctive feature of which is the device of halving the link at the point of junction with the next link in the series, making an uninterrupted sequence which, it is claimed, prevents the admission of excess air. The grates are fitted to water-tube boilers of the B. & W. type. An 8-hour test made with new slack, having a calorific value of 12,012 B.TH.U., gave an evaporative duty, as from and at 212° F. per lb. of coal, of 9·7 lb., and a total thermal efficiency of 78 per cent. Two chain-grates were at first supplied to the order of the Corporation, and the results being in every way satisfactory, the order was given for two additional grates. The grates are working with natural draught. This and other successful installations are mentioned in a pamphlet on "Chain-Grate Stoking," recently issued by Messrs. Bennis, copies of which may be had on application.

Italy.—H.M. Consul at Rome (Mr. C. C. Morgan) reports that an agent in that city wishes to secure the representation of United Kingdom manufacturers of electrical goods. The name can be ascertained at the Board of Trade Commercial Intelligence Branch, London. Other inquiries should be addressed to the British Consulate, Rome.

Book Notices.—The *Practical Electrician's Pocket-Book and Diary.* Edited by H. T. Crewe. London: S. Rentell and Co. Price 1s. net.—The sixteenth edition of this popular pocket-book has been issued, having undergone an exceptional rearrangement and condensation; new chapters have been added, on electric clocks, electricity in coal mines, and distributing systems, and new sections deal with half-watt lamps, C.T.S. wiring, Zed fuses, &c. Not the least of the attractions of this little companion is the neat format and excellent printing by which it is distinguished; the illustrations are particularly good, and so long as the present high standard of production and composition is maintained, the book need fear no competitor.

"Samuel F. B. Morse: His Letters and Journals." Edited by E. F. Morse. London: Constable & Co. Price 31s. 6d. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LIII, No. 239. January, 1915. London: E. & F. N. Spon, Ltd. Price 3s. 6d.

"*Transactions* of the North-East Coast Institution of E gineers and Shipbuilders." Vol. XXX, Part 6. December, 1914. Newcastle-upon-Tyne: The Institution. Price 5s.

"*Bulletin* de la Société Internationale des Electriciens." Vol. IV (3 series), No. 37. July to December, 1914. Paris: Gauthier-Villars et Cie. Price 2 fr. 50.

"Automatic Telephony." By A. B. Smith and W. L. Campbell. London: Hill Publishing Co., Ltd. Price 17s. net.

Deed of Assignment.—GEO. BRAULIK, 8, Lambeth Hill, E.C., &c., electrical engineer.—Mr. G. E. Corfield, the trustee in this matter, in giving a statement of his receipts and payments, says that the terms contained in the deed of composition and assignment between the debtor and his creditors, has so far been carried out. The trading operations of the debtor, under his supervision, are being well maintained, and he expects to be able to fully carry out the conditions of the deed and eventually discharge the whole of the said composition of 10s. in the £.

Trade Announcements.—The business of Alderman R. H. Mason, electrical and general engineer, of Lorne Street, Oswestry (Salop), has been taken over by MESSRS. DARLING AND LLOYD.

THE MIDLAND ELECTRIC WIRE CO., LTD., or Leicester, have removed to Lutterworth, and all communications should be addressed there in future.

The address of the firm mentioned in the first of our trade announcements last week, is 32, County Buildings, Corporation Street, Birmingham, not 32, Corporation Street.

LIGHTING and POWER NOTES.

Accrington.—NEW GAS PLANT.—The electrical engineer reports that the new No. 3 gas producer plant is now in operation, and the gas cleaning and sulphate plant has had trial runs. The gas-engine plant arrangements are progressing, but only one new engine is at present in use. The total fuel cost per unit generated by the steam plant was ·379d., and for gas plant ·273d.

Argentina.—Residents in the city of Santiago del Estero being dissatisfied with the charges made by the Compania Eléctrica del Norte, appointed a Special Committee to study the contract made between the Government and that company. As the municipal authorities will do nothing, the public have decided to defend themselves. The Committee thinks that the reason of this municipal indifference is that they owe the company more than $20,000, and do not, therefore, dare intervene.—*Review of the River Plate.*

Ascot.—SEWAGE PUMPING.—The Windsor R.D.C. has decided to consider electricity for sewage pumping as an alternative to the Diesel plant originally proposed. The estimated capital cost of the installation—current being taken from the local works—is £4,775, made up of the following items:—Mains in duplicate, booster, &c., £2,750; two 100-H.P. motors and pumps, one 80-H.P. motor and pump, £1,200; building, £500; foundations £100; contingencies, £225. The estimated annual cost is £720.

Australia.—The Melbourne City Council is proposing to substitute metal filament for carbon lamps for renewals of not less than 40 watts and to charge an extra ½d. per unit when such renewals are carried out by the Council.

It is proposed to invite tenders for 62,500 assorted metal lamps, at an estimated cost of £3,906. The city electrical engineer estimates a reduced revenue of £6,000 per annum owing to the change.

The Coonamble (N.S.W.) Municipal Council has entered into an agreement with the Australian Electric Supply Co. for electric lighting in the town.

The Toowong (Q.) Council has decided to establish an electric lighting scheme for the town and to apply for an Order in Council.

The Dalby (Q.) Council has prepared plans and specifications for an electric lighting scheme.

The Brunswick (Vic.) Council has accepted the offer of the Commonwealth Bank of a loan of £10,000, for extending the electric light and power system in the city. It is proposed to introduce electricity into every street in the municipality.—*Tenders.*

Barrow.—The electrical engineer reported that it would be necessary, at an early date, to consider some further extension, with a view to maintaining the pressure at Walney. A 150-KW. rotary converter has now been installed at the Furness Railway Works, and a balancer and switchgear has been fitted in the Furness Abbey sub-station.

Beaconsfield.—In order to safeguard the Council's interests, the U.D.C. has decided to formally oppose the London Electric Supply (No. 2) Bill.

Belfast.—EXTENSION SCHEME.—The Corporation has approved, subject to certain conditions, of the extension scheme submitted by the Tramways and Electricity Committee on the report of the city electrical engineer; the cost is estimated at £28,301.

Birmingham.—TEMPORARY SUPPLY STATION.—At a recent meeting of the City Council, the Electric Supply Committee were to ask permission to erect and equip a temporary supply station at Nechells, at an estimated cost of £97,000, to meet the urgent demands of local manufacturers engaged on Government work. In view of the urgency of the work it is proposed to proceed with it in anticipation of L.G.B. sanction. To meet normal demands it was intended to install 5,000 KW. of temporary plant at the Aston Manor station, but since the end of September applications for the supply of 11,000 KW. for power purposes have been received, and a still greater demand is anticipated. Of the estimated £97,000 to be spent on the temporary plant, some £10,000 for buildings, foundations, &c., will cease to be remunerative when the plant is dismantled. The permanent Nechells power station will not be available for supply purposes until the winter of 1916-17.

Bradford-on-Avon.—PROV. ORDER.—The U.D.C. has sent a letter to Mr. J. H. Elwards, of Bristol, asking when he intends exercising the powers granted him by the prov. order for E.L.

Bradford.—It is stated that despite the war, the number of units turned out at the electricity works is constantly increasing. Slight extensions of plant are being made when new textile buildings are erected, but, says our correspondent, it appears to be a somewhat difficult task to persuade owners of old mills to install electricity.

Brighouse.—The Electric Power Sub-Committee has recommended the Electricity Committee to make a further reduction of 1d. per unit for the supply of energy through a generator for cinematograph purposes, subject to a minimum consumption of 3,000 units per annum.

Chile.—A decree has been published approving the scheme presented by Don Herman Bernales for the installation of an electric lighting and power system for the town of Casablanca. —*Board of Trade Journal.*

Continental Notes.—BELGIUM.—The Belgian town of Zeebrugge, which has become prominent during the war, is at the mouth of the Bruges Ship Canal. Its entrance lock is equipped with 80-ft. wide rolling gates operated by electric motors. An adjacent power station, which contains two 200-H.P. Willans steam dynamos supplying D.C. at 440 volts, is reported to have been destroyed by British warships, together with the lock gates.

SPAIN.—A concession has been granted to the Sociedad Anonima Hidro-electrica Ibérica, to utilise the waters of the Rio Mijares, in the district of Fanzara, for the production of electric power.—*Board of Trade Journal.*

Coventry.—NEW SUB-STATIONS.—The City Council has decided to purchase land in Walsgrave and Foleshill Roads, for the erection of electricity sub-stations.

Cuckfield (Sussex).—PROV. ORDER.—The B. of T. has called the attention of the R.D.C. to the stipulations of the prov. order granted to the Mid-Sussex E.L. and P. Co. which had not been carried out, and asking for the Council's observations as to the order being revoked. The Council has decided to make no observations on the subject.

Darlington.—EXTENSION SCHEME.—The Electricity Committee has prepared a scheme for the extension of the works, comprising new generating plant and the erection of larger buildings, the cost being estimated at £20,000.

Dover.—NEW PLANT.—A Sub-Committee of the Electricity Committee has been formed for the purpose of considering the steps to be taken to provide for additional alternating current plant, to ensure completion of the work by next autumn.

Edinburgh.—ELECTRICAL TRADES PROTEST.—The local electrical traders have petitioned the T.C. against the clauses in the proposed prov. order, giving the T.C. power to supply and hire electrical apparatus (except for lighting), and to open showrooms in the city, &c. The protest has been signed by a 100 firms in the trade as well as by 35 firms on behalf of the local Ironmongers' Association. Amongst other things, it is stated that the Corporation has not accepted the offer of co-operation by the traders made as a result of previous proposals of the same kind. There are also numerous private electrical showrooms in the city. The terms of the prov. order will be considered by the T.C. on January 12th.

Esher.—THAMES FLOOD.—Owing to the flooding of the river at Molesey, water entered the low-lying pipes of the Twickenham and Teddington Electric Supply Co., and the Esher supply was cut off.

Finchley.—YEAR'S WORKING.—With reference to the note which appeared in our last issue under this head, we are informed that there was a credit balance shown in last year's accounts of £2,278, not a debit balance of £2,116, as mentioned by our correspondent.

Frinton.—The Frinton and District E.L. and P. Co., Ltd., has decided to appeal against the assessment of its undertaking. The appeal will be defended by the Assessment Committee of the Tendring Union.

Glasgow.—For about 15 minutes, on Saturday evening, the centre of the city was deprived of its electric light, and much inconvenience was caused among the shopping crowds and the spectators at picture houses. The cause was a short circuit on two of the mains leading from Port Dundas power station, with the consequent overloading of the machinery running at the time. As the tramways department supplies its own power, the cars were not interfered with.

Greetland.—The Electrical Distribution of Yorkshire, Ltd., has informed the U.D.C. that it had not been able to proceed with the erection of the sub-station at Greetland on account of the war, but the estimates for the station would be considered early in the new year, and it was hoped that the building would soon be in course of erection.

Halifax.—The Electricity Committee has refused an application made by the War Refugees' Committee for the free use of electricity in the houses occupied by Belgian refugees.

India.—According to the *Indiaman* the Madras Government has had before it during several years a scheme for generating electric power from the Pijkara Fall for the purpose of lighting the principal stations on the Nilgiris. As it is more than probable that this enterprise will not soon emerge from its present form, the Municipal Council of Ootacamund has passed a resolution, subject to the approval of Government, sanctioning the employment of Mr. Fulton, representing a Ceylon firm of electricians, to prepare plans and estimates for a proposed scheme to light the station and supply power to private and business houses. The idea is to derive the power from the St. Lawrence Lake. The estimated cost of the enterprise is Rs. 50,000.

Llandudno.—PROPOSED LOAN, &c.—The Urban Council has decided to make application to the L.G.B. for sanction to borrow £926 for supplying and laying a new feeder cable from the works to a feeder pillar to be erected in Mostyn Street. The Council refused the application for a free supply of electricity for the headquarters of the local Battalions of the Welsh Army Corps, and ordinary rates are to be charged.

London.—GREATER LONDON SCHEME.—The Standing Conference of Metropolitan Municipal Electricity Undertakings has passed a resolution to the effect that the L.C.C. electricity scheme is prejudicial to the development of electricity supply in London, and to the interests of the Borough Councils owning electricity undertakings, and contrary to the interests of the ratepayers.

BETHNAL GREEN.—The Electricity Committee is to submit to the B.C. an estimate of £15,944 for the supply and laying of cables, &c., in connection with the new electricity undertaking. The Committee proposes to stipulate in the contract for cables and accessories that they shall be of British manufacture.

WOOLWICH.—BULK SUPPLY, LOANS, &c.—The B. of T. has sanctioned the arrangement for bulk supply of electricity between the Woolwich B.C., the South Metropolitan Electric Light Co. and the West Kent Electric Co.

The Electricity Committee has consulted Sir John Snell with a view to his report, submitted to the Council in 1912, being brought up to date. This report has been considered by the Committee, and an estimate has been forwarded to the Finance Committee of the further expenditure, amounting to £32,935, necessary to complete the works recommended. In addition to the 3,000 KW. turbo-alternator now on order, further boilers, and another 1,000-KW. motor-converter are necessary. The Council has authorised the Committee to obtain tenders for the necessary plant, and, if necessary, the services of Sir John Snell will be obtained to interview the L.C.C with a view to obtaining the longest periods for the repayment of the proposed loan.

MARYLEBONE.—The returns of the Electricity Department, for the September quarter of 1914, show that 2,811,607 units were sold, a decrease of 972 units as compared with the previous year. The revenue was £30,203, an increase of £43, and the generation and distribution expenditure £15,152. Due to more economical plant the generating costs were ·573d. per unit as against ·644d. in the 1913 September quarter. For the half-year to September 30th, the amount available for capital charges was £31,597 as against £29,992, and the increase in the available balance amounts to £1,605.

The B.C. has decided to petition against the L.C.C. Greater London Supply Bill and the London Electric Supply (No. 2) Bill.

Maidenhead.—The T.C. has decided to appoint a station superintendent at the electricity works, in order to free the electrical engineer for other necessary duties.

Manchester.—Owing to the darkness of the Christmas holidays, the consumption of electricity for the three days showed a considerable increase, the figures being, for 1914, 594,400 units, and, for 1913, 583,820 units, an increase of 10,580 units.

A representative of the Withington Committee of the Corporation has been deputed to interview the chairman of the Electricity Committee as to lighting main roads at Withington by electricity.

New Zealand.—LAKE COLERIDGE SCHEME.—The inauguration of the hydro-electric power scheme took place on November 25th, the Premier, the Hon. W. F. Massey, switching on the current.—*New Zealand Shipping and Commerce.*

Nottingham.—PROPOSED LOAN.—The Electricity Committee is recommending the City Council to apply for sanction to borrow £20,000 for underground mains and services.

Oldham.—SUPPLY OF MOTORS.—With reference to complaints which have been made by the Chamber of Trade that the electricity department of the Corporation is competing with the local electrical traders in the supply of motors, a deputation of the E.L. Committee is to meet the Chamber to make a statement on the matter. At a meeting of the Electricity Committee last week it was stated that the complaints of the Chamber were very unfair. The Committee tried to work with the traders, but if a man came to the electricity station and would not go to a private trader for a motor, it was only natural that the Corporation should supply him, rather than lose a customer for energy.

LOAN SANCTION.—The T.C. has received the sanction of the L.G.B. to a loan of £40,000 for additions to the plant at Greenhill Works, and for the provision of cooling towers.

Runcorn.—PROV. ORDER.—Subject to the work being carried out within a given period, the R.D.C. has decided to consent to the application of the Warrington T.C. for a prov. order in the parishes of Stockton Heath, Latchford Without, Thelwall, Grappenhall, Lower and Higher Walton, and Appleton.

Salford.—PROPOSED LOANS, &C.—The Electricity Committee has decided that in all cases where separate premises in the occupation of one consumer are supplied with energy at the sliding scale of charges, such premises be regarded as separate premises, and charged accordingly, except in the case of a consumer under contract where the conditions of supply are specifically agreed upon. Application is to be made to the L.G.B. for sanction to borrow £18,252 for the provision and equipment of a transformer station in the Greengate District, and £25,000 for the extension of H.T. mains and provision of L.T. mains.

Walsall.—The R.D.C. has concluded an agreement with the Walsall Corporation for a supply of energy to the new pumping station at Rushall. A new showroom was opened on Tuesday, in connection with the Sales Department.

West Bromwich.—PROPOSED LOAN.—The T.C. has been recommended to apply for sanction to borrow £2,450, required to cover the cost of future extensions of mains.

Wimbledon.—The B.C. has decided to supply electrical energy to houses occupied by Belgian refugees and their helpers, also to the Wimbledon Recruiting Committee for lighting purposes at 1½d. per unit.

The borough electrical engineer, as the result of a canvass in Worcester Park, is to include applications signed by 17 residents in the application to be made for permission to supply electricity in certain roads in Worcester Park.

Wrexham.—The T.C. has arranged to supply current to the military huts being erected at 3d. per unit, and to extend the mains along King's Mills Road, to supply new property, and to provide five public electric lamps in place of gas.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—TRAMWAY PURCHASE.—The Corporation Tramways Committee has received a letter from the Suburban Tramways Co. regarding the proposed purchase of the undertaking by the T.C., stating certain terms and conditions upon which a basis of purchase might be arranged. It is understood that the terms mentioned would be about equal to a payment of 30s. per share to the shareholders of the company.

A petition against P.A.Y.E. cars from users of the tramways in Great Western Road and adjoining streets has been sent to the T.C. The petitioners state that these cars are disliked by both drivers and conductors; that risk of accidents is incurred by drivers having to operate the barrier regulating the exit, thereby diverting their attention from the front; and that the conductors have to stand on the platform of the car practically motionless, having no opportunity of exercise, and consequently during the winter season the cold will be most trying. The petition concludes by asking that these cars be at once discontinued, and the former system reverted to.

Brighouse.—The General Purposes Committee has decided not to consent to the Halifax Corporation's tramway proposals in Brighouse.

Belfast.—The Corporation tramways are not giving the results anticipated, the reason given being the number of extensions recently made, which have not proved remunerative enough to defray the expenses incurred. The war, too, has seriously affected the traffic, no fewer than 16,000 Belfast men, exclusive of reservists and special reserve men and yeomen, having left to join the new armies since the war opened.

Chile.—The anti-German riots in Valparaiso, originating in the doubling of the tramway fares, were repeated for several days and necessitated cavalry charges, in which several persons were injured, to disperse them. In the meantime the tramway cars have been boycotted.—*Review of River Plate.*

Continental.—ITALY.—Electric traction has just been introduced on the Turin and Savona Railway, for passenger traffic only, on the section of the line across the Apennines, between the latter town and Coval, a distance of 29 miles. This section, which is the heaviest part of the line, includes the Belbo tunnel, about 3 miles in length, with maximum gradients of 1 in 40. The maximum speed is 31 miles per hour. Savona, after Genoa and Venice, is the principal coal port in Italy; it is also an important manufacturing town, with large steel works.—*Railway Gazette.*

Derby.—ELECTRIC TOWER WAGON.—The Corporation has purchased an Edison electric tower wagon for use in connection with the electric tramways. The vehicle, the chassis of which is designed for a load of 20 cwt., is equipped with a battery of 60 Edison cells having a capacity of 190 ampere-hours, or sufficient to enable a distance of 42 miles to be covered, at an average speed of 12 miles per hour.

Doncaster.—PROPOSED LOAN.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £8,550, £5,500 of this being for the purchase of six new tramcars.

Halifax.—PROPOSED TRAMWAY EXTENSION.—The Tramways Committee has decided to extend the tramway track to Southowram, on condition that the Southowram U.D.C. guarantees to pay £200 per annum for the first five years, £150 per annum for the second five years, and £100 per annum thereafter, such payments to terminate when the undertaking to Southowram is financially successful.

Huddersfield.—Arrangements for the extension of the tramways *via* Bradford Road to Brighouse have now been completed by the two Corporations.

London.—STEPNEY.—With reference to the opposition of the B.C. to the electrification of the L.C.C. tramways in Grove Road and Burdett Road, except on the conduit system, the B. of T. has intimated to the Council that it would not be prepared to withhold consent from the proposals of the County Council on the ground that that authority do not propose to equip the line on the conduit system, or on the ground that the lines are to be renewed in such a way as to facilitate their equipment for electric traction on the overhead trolley system. The Board submitted a copy of a communication from the Poplar B.C. showing that the boroughs of Poplar, Hackney and Bethnal Green have agreed to the overhead system, &c.

Northampton.—Owing to the war, the new tramway to Far Cotton has not yet been fully brought into use, due to the delay in completing a railway crossing near the terminus. It is hoped that as a result of negotiations with the railway company the full service will shortly be inaugurated.

Rhondda.—PROPOSED TRAMWAY EXTENSIONS.—The U.D.C. is applying for powers to construct additional lines of electric tramways in the district.

Salford.—CAR-SHED EXTENSION.—The T.C. is to be recommended to apply for permission to borrow £6,553 to cover expenditure connected with the erection and completion of a proposed extension to the central car depôt at Pendleton.

Stainland.—The U.D.C. has decided to support the Halifax Corporation Bill, which provides for extensions to the tramway system.

Stoke-on-Trent.—TRAMWAY ACCIDENT INQUIRY.—As a result of the Coroner's inquest into the death of the driver—who was found dead on the platform of his car after it had run away on December 14th—evidence was given showing that the car was equipped with the air-brake, but that only the driver could control it; also that the conductor did not apply the hand-brake on account of the greasy nature of the rails. Medical evidence showed that the driver died through rupture of an aneurism of the heart, which might result from a sudden strain, and that this would not have been detected from examination. On behalf of the company it was stated that some of the cars were so equipped that the conductor could control the air-brake, but people might tamper with the apparatus. Mr. Dickinson, Birmingham Corporation tramways, who examined the car and found it in good order, said that his Corporation had 300 cars fitted with a controlling device at the rear, and more were on order. The verdict was in accord with medical evidence, with a rider respecting the provision of rear control of the brakes.

U.S.A.—TUBE RAILWAY FIRE.—On Wednesday morning an outbreak of fire occurred on the New York Subway at a time when it was crowded with traffic. We gather that some cable insulation became ignited at a time when, according to the *Times*, some 500 trains, containing 300,000 people, were at a standstill. Several hundred passengers were rendered unconscious by the smoke, and were rescued by through gratings at street-level by the fire brigade, one person being killed and at least 200 injured. The subway service will be suspended for some days.

TELEGRAPH and TELEPHONE NOTES.

A Telephonic Probe.—In the *British Medical Journal* Sir J. Mackenzie Davidson points out the difficulty of accurately localising a bullet or other foreign body with the X-rays, unless stereoscopic X-ray photography is employed. On the other hand, he states that the telephone can be advantageously used for this purpose by connecting one terminal to a moistened electrode which is applied to the patient's skin, and the other terminal firmly to a metallic instrument such as a probe or forceps. Directly the probe touches metal embedded in the tissues, a grating sound is heard in the telephone, due to the voltaic cell thus formed. This method, especially when employed in conjunction with stereoscopic photography, greatly reduces the time occupied in the search and the disturbance to the patient's tissues. On the other hand, it is stated that in modern warfare the removal of bullets from the body is not very necessary, as their presence is usually without harmful effects.

Argentina.—The Government having proved that two steamers belonging to the Hamburg South American Co. which fly the Argentine flag had misused their wireless installations, thereby infringing Argentine neutrality, has issued a decree on the question. By this all coasting vessels are to have their apparatus sealed by the port authorities, and some are only to be used in case of danger. Wireless operators are to be Argentine citizens and will be considered as agents of the maritime authorities.—*Review of River Plate.*

Bolivia.—Owing to difficulties which have arisen in connection with the carrying out of the contract entered into some months ago by the Government of Bolivia and the Marconi Co., for the erection of a number of wireless stations, Congress has now authorised the Executive Power to rescind the contract.—*Review of River Plate.*

Cheap Telegrams for the Forces.—Special arrangements have been made for the transmission of week-end letter telegrams at about one-fourth the rate of ordinary telegrams between British sailors, soldiers and nurses in Europe and the extra-European British possessions. Inquiries concerning casualties will be transmitted free of charge. These arrangements do not apply between this country and the Continent.

Illicit Wireless Apparatus.—Amateurs who have not surrendered or otherwise got rid of their wireless apparatus of all kinds should take warning from the case of R. Softley, of Ramsgate, who was fined £15, with the alternative of six weeks' imprisonment, for being in possession of apparatus in sections without the written permission of the Postmaster-General. Evidence was given that the parts could have been assembled in four hours, and would then have been capable of receiving wireless messages from Germany.

Romford.—The master of the Romford Workhouse is to draw up plans and estimates for reorganising the whole of the intercommunicating telephone system, the service having been disorganised owing to the recent rough weather. It is proposed to connect up five more buildings in the institution.

Storm Interruptions.—The effects of the storm on December 28th were even more serious than was at first supposed, especially in respect of telephonic communication; up to Friday last London was cut off from the north beyond Birmingham, from the West of England and from Ireland. The telegraphs were much less affected. The trouble was much reduced by the effective co-operation of the telegraphs and telephones. The interruptions were due to the force of the wind, and not, as usual, to soft snow clinging to the wires.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—March 15th. Municipal Council. Transformer testing apparatus. Specification from City Electrical Engineer. A copy can be seen at the Board of Trade C.I. Branch in London.

ADELAIDE.—January 27th. Accumulators, and power board, for Postmaster-General. See "Official Notices" December 18th.

February 10th. Testing instruments, for Postmaster-General. See "Official Notices" January 1st.

February 17th. Victorian Railway Commissioners (Spencer Street, Melbourne). 3,300 tons of steel rails, 232 tons of steel fish-plates, 5,000 flame arc carbons for arc lamps. Specification, &c., may be seen at the Board of Trade Commercial Intelligence Department in London.

BRISBANE.—January 13th. Switchboard cable, for Postmaster-General. See "Official Notices" to-day.

March 10th. Motor-generator, power board, &c., for Postmaster-General. See "Official Notices" to-day.

PERTH.—February 10th. Telephone switchboards and parts, for Postmaster-General. See "Official Notices" to-day.

Beckenham.—January 25th. U.D.C. One 120-KW. D.C. generator and switchgear to couple to 120-KW. steam alternator. See "Official Notices" to-day.

Birkenhead.—January 12th. Twelve months' supply of electric motors and motor-starters, from ¼ to 15 H.P., for the Corporation electricity supply. See "Official Notices" Dec. 18th.

Bolton.—February 11th. Corporation. Low-tension sub-station switchgear, for the Electricity Department. See "Official Notices" to-day.

Croydon.—January 25th. General stores, for the Corporation Tramways Department, for a year. The Manager, Thornton Heath.

Dublin.—January 13th. Twelve months' supply of electrical fittings, for the Dublin Port and Docks Board. Forms of tender from the Secretary, Port and Docks Office, Westmoreland Street.

Hong Kong.—January 15th. Two 1,500-KW. (2,000 K.V.A.) turbo-alternators with condensing plant and switchboards, E.H.T. cable, sub-station switchboards and transformers, for the North Point generating station. See "Official Notices" Dec. 18th.

Leeds.—January 22nd. Overhead electrically-driven travelling crane, coal and ash-conveying plant, for Electric Lighting Department. See "Official Notices" December 11th.

January 16th. Steam coal (small slack, smudge, or similar material), for the Electric Lighting Department, during the year ending March 31st, 1916. Mr. C. N. Hefford, Manager, 1, Whitehall Road.

Leyton.—U.D.C. Repairs, &c., to cooling tower, for Lighting Committee. See "Official Notices" December 18th.

Liverpool.—January 14th. Electrical generators and switchboard at Mill Road Infirmary, Everton, for West Derby Union. Mr. H. P. Cleaver, Union Offices, Brougham Terrace, Liverpool.

London.—L.C.C.—January 26th. Platelaying, &c., for electric tramway, Grove Road and Burdett Road, &c. Specifications, &c., from Mr. G. W. Humphreys, County Hall, Spring Gardens, S.W.

January 12th. Two steam turbo-generators of 8,000 KW., with auto-transformers, &c., for Greenwich generating station. See "Official Notices" January 1st.

Manchester.—January 19th. Tramways Committee. (*a*) Permanent way special track work, and (*b*) permanent way points, tongues, and hardened steel centres. Specifications, &c. (£1 1s. returnable), from Mr. J. M. McElroy, general manager.

New Zealand.—WELLINGTON.—February 28th. Public Works Department. 18 step-down transformers, for the Lake Coleridge power scheme. Specification at the Public Offices, Wellington.

Plymouth.—January 21st. Corporation. Twelve months' supply of carbons, A.C. meters, transformers, cables, oils, waste, &c. See "Official Notices" to-day.

Redditch.—U.D.C. Two turbo-alternators, each 1,000 KW., with condensers, cooling tower, &c.; two synchronous motor-alternators of 300 KW. and 150 KW. respectively. See "Official Notices" to-day.

Shanghai.—January 12th. 68 three-phase induction motors, various sizes between 5 and 60 B.H.P., with slide rails and liquid starters, for Municipal Council. See "Official Notices" December 25th.

Spain.—CANARY ISLANDS.—February 25th. Direccion General de Obras Publicas, Madrid. Construction and working, for a period of 60 years, of an electric tramway in San Cristobal de la Laguna, in the Canary Islands. An option on the concession is held by the "Sociedad Tranvias Eléctricos de Tenerife."—*Board of Trade Journal.*

February 10th. Four electric cranes, for the Junta de Obras del Puerto de Valencia, Valencia. Particulars may be seen at the Board of Trade Commercial Intelligence Department, London.

February 10th. Electric lighting installation at Teruel. Municipal Authority.

Tunbridge Wells.—January 26th. Cooling tower and pipework, two water-tube boilers, economisers, mechanical stokers, pipework, and feed heater, for Borough Electricity Works. See "Official Notices" January 1st.

CLOSED.

New Zealand.—The Auckland City Council has accepted the tender of Messrs. Richardson, M'Cabe & Co. for overhead cables, £943; lead-sheathed, £4,210 8s.; V.B. cables, £1,516.

Bradwell.—The Joint Isolation Hospital Committee has accepted the tender of Mr. John Richards, of Leek, for the installation of the electric light at the new hospital buildings, at £415. Three tenders were received, the highest being £494.

Derby.—The T.C. has accepted the tender of Messrs. Newton Bros. for an electric hoist, with motor, at £52 1s.

Dundalk.—The U.D.C. has received the following tenders for electric light wiring for artisans' houses:—Mr. T. P. Curran, Broughton Street, £73 19s. 8d.; Messrs. Gaskin Bros., £66; and Mr. P. J. Watters, £79 13s. It was decided to accept the lowest tender, and to have all the houses wired, the engineer to submit a scheme which would enable electricity to be supplied for cooking purposes.—*Irish Builder.*

Eccles.—The Electricity Committee has accepted the tender of the British Westinghouse Co. to supply consumers' meters for a period of 12 months.

Glasgow.—The T.C.'s Committee on Health recommends acceptance of the offer (£3,976) by Messrs. Johnston, Park & Co., Glasgow, for the electrical installation at the new hospital at Robroyston. The Clyde Navigation Trustees have accepted an offer by Mr. Lackie, on behalf of the Glasgow Corporation, to make, for £105, the extension of the switchboard panels for the main cable connections in the electric sub-station at Yorkhill.

Grimsby.—The Public Lighting Committee recommends the acceptance of the tender of Messrs. Ed. Bannister & Co., Ltd., for an annual supply of Sherwood fine slack to the electricity works, at 6s. 4½d. per ton.

Liverpool.—The City Council has been recommended to accept the tender of the Edison Accumulators, Ltd., for the supply of a 2-ton battery electric motor vehicle for the Tramways Committee.

London.—STEPNEY.—The Electricity Committee reports having purchased 5,320 tons of coals for the Electricity Department at prices varying from 11s. to 16s. per ton.

The following quotations have been received by the Electricity Committee for a supply of carbons:—

	Per 1,000 pairs.
British Central Electrical Co., Ltd., France (accepted)	£13 3 0
National Carbon Co., U.S.A.	(F.A.S. New York) 10 16 6
Heap & Johnson, U.S.A.	15 12 6
The Electrical Engineering and Equipment Co., Ltd., Switzerland	16 0 0

The Committee states that it understands that there is only one firm at present manufacturing carbons in this country, and that this particular firm are not at the present time manufacturing carbons of the type required.

BETHNAL GREEN.—The B.C. Electricity Committee has received the following tenders for the supply of high and low-tension cables and for the execution of roadwork in connection with the scheme for the supply of current in the borough:—

Brit. Insulated & Helsby Cables, Ltd.	(recommended)	£12,499
W. T. Henley's Telegraph Works Co.		12,586
Johnson & Phillips, Ltd.		12,618
Siemens Bros. & Co.		12,661
Western Electric Co.		12,734
Callender's Cable and Construction Co.		12,887
W. T. Glover & Co.		12,943
Union Cable Co.		12,949

Mr. H. W. Couzens says that the tender recommended is the lowest in point of view of the lump sum and also the schedules for the various classes of work required. The price quoted shows a saving roughly of £2,000 on Sir John Snell's estimate for the work contemplated, which, the Committee states, is largely due to the decrease in the price of copper. In view of the fact, however, that the price of copper is rapidly advancing upon the market price which obtained at the date of the tender, the Committee states that it is desirable that the contract should be proceeded with as early as possible, and it has, therefore, decided in accordance with Mr. Couzens's recommendation. The following tenders have been received for the supply of transformers and high and low-tension switchgear:—

	Two 500-K.V.A. and two 250 K.V.A. 3-phase transformers.	H.T. and L.T. switchgear for two sub-stations.	Total.
Johnson & Phillips, Ltd.	£924	£2,132	£3,056
Brit. Westinghouse Co. (recommended)	1,086	2,362	3,446
Electric Construction Co.	940	2,587	3,527
British Thomson-Houston Co.	1,122	2,705	3,827
Siemens Bros. Dynamo Works, Ltd.	1,100	3,050	4,150
Ferranti, Ltd.	996	Incomplete.	
Alternative	932		
Brush Electrical Engineering Co.	900	—	—
Alternative	950	—	—
British Electric Transformer Co.	995 10s.	—	—
Alternative	1,004	—	—
Ferguson, Pailin & Co.	—	2,126	—
General Electric Co.	—	2,500	—
Switchgear & Cowans	—	2,856	—
Reyrolle & Co.	—	3,271	—
Electrical Apparatus Co.	—	5,960	—

Reporting upon these tenders, the Committee states that in each section the lowest tender is based upon the assumption that the contractors will supply materials differing in some respects from those included in the specification. Mr. Couzens recommends the acceptance of the tenders of the British Westinghouse Co., which are practically identical with the specification. In this instance also the amount of the tender shows a substantial saving as compared with Sir John Snell's estimate.

Messrs. Napier-Kimber, Ltd., have received the contract for wiring for electric light at the National Health Insurance Commission, Leonard Street, E.C., for H.M. Office of Works.

Manchester.—The Educational Committee has accepted the tenders of Messrs. R. O'Brien & Co. and Messrs. R. Seddon and Sons for electrical work in various schools.

The Tramways Committee has accepted the tender of the J. G. Brill Co. for tramway trucks.

West Bromwich.—The tender of the British Westinghouse Co. is recommended to the T.C. for acceptance for a supply of E.H.T. and L.T. switchgear, and rheostats; as is also that of the New Conveyor Co. for extending the coal bunkers at the works.

Woolwich.—The following tenders have been accepted by the Electricity Committee:—

John Spencer & Co.—Steam pipes, £91.
Mechan & Sons.—Water and exhaust pipes, £169.
Herbert Morris, Ltd.—Travelling crane, £355.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, January 9th. At 3 p.m. At Albemarle Street, W. Juvenile lecture on "Light in the Home," by Prof. C. V. Boys, F.R.S.

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, January 9th. At 6 p.m. At Carlton Café, Queen Street, Cardiff. Paper on "The Prevention of Electrical Accidents in Mines," by Mr. T. J. Nelson.

Institution of Mechanical Engineers (Graduates' Association).—Monday, January 11th. At 8 p.m. At Storey's Gate, S.W. Paper on "Semi-Diesel Engines," by Mr. R. A. Ffeiderer.

Junior Institution of Engineers (Midland Section).—Tuesday, January 12th. At 8 p.m. At Imperial Hotel, Temple Street, Birmingham. Ordinary Meeting.

Association of Engineers-in-Charge.—Wednesday, January 13th. At 7.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Electric Accumulators," by Mr. R. T. Mitchell.

Greenock Electrical Society.—Thursday, January 14th. Visit to Babcock and Wilcox's Works, Renfrew.

Institution of Electrical Engineers.—Thursday, January 14th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Shape of the Pressure Wave in Electrical Machinery," by Dr. S. P. Smith and Mr. R. S. H. Boulding.

Manchester Local Section.—Tuesday, January 12th. At 7.30 p.m At the Engineers' Club, 17, Albert Square. Paper on "The Shape of the Pressure Wave in Electrical Machinery," by Dr. S. P. Smith and Mr R. S. H. Boulding.

(Scottish Local Section).—Tuesday, January 12th. At 8 p.m. At Princes Street Station Hotel, Edinburgh. Paper on "Cables," by Mr. C. J. Beaver.

(Yorkshire Local Section).—Wednesday, January 13th. At 7 p.m. At Philosophical Hall, Leeds. Paper on "Automatic Protective Switchgear for Alternating-Current Systems," by Mr. E. B. Wedmore.

NOTES.

Copper.—The quantity of copper in stock and generally available for European consumption, known as European supplies, is, at the present time, of only relative value in estimating the copper position, as no returns of French or German stocks have been issued since July 31st, 1914. Messrs. Merton's statistical tables for December 31st, 1914, give this quantity as 35,432 tons. Deducting French and German stocks, the figure is 25,923, compared with 26,240 tons at the end of November, and 21,558 tons (with the same omissions) for the end of December, 1913. The figure for English stocks is 21,098. The quantity under the same head at the end of 1913 was only 15,258 tons.

Compared with the average for the 12 months ending July 31st, 1914, American supplies are still low, and Spain and Portugal to England and France, very low. From the not specifically detailed source "other countries," however, 8,521 tons have been received during the month, nearly double the average quantity received before the war. Chile shipments for December, 1914, were well above the pre-war average, Australian shipments being still rather below. Total deliveries, at 31,708 tons, are 9,167 tons higher than the preceding month.

Institution and Lecture Notes.—Birmingham and District Electric Club.—The tenth annual report of this club shows steady progress. The membership stands at 80 as compared with 72 on the corresponding date in the previous year. Mr. A. E. Morgan, who had been hon. treasurer since the formation of the club, resigned, and, as a mark of appreciation of his services, he was unanimously elected as hon. life vice-president. The report ended with a reference to the temporary loss of the valuable services of the popular hon. sec., Mr. W. G. L. Riddle, business calling him to the Far East. It was decided that the ordinary member's subscription should be reduced from 6s. to 5s. per annum. The balance in hand was £22 10s. 8½d.

Electrical Association of Australia. — The first annual general meeting of the Victorian Section of the Association took place on Monday, November 30th, when the formation of the new Society was celebrated by means of a "Smoke Social Evening." The Victorian Institute of Electrical Engineers has joined with the N.S.W. Electrical Association under the above new title; the the V.I.E.E. forms the Victorian Section.

What did the Glass Contain?—"Now we see only in a glass darkly, but when on the conclusion of peace we see things clearly we shall realise the degree of stability and stamina which has sustained the body commercial during the period of the war. It may be that *even our ancestors* will marvel that the strain, the wearing, nervous strain of the war, could have been borne with such fortitude, equanimity and resource, and with so little effect upon the everyday routine of the industry." That round table has much to answer for!

Portable Chemical Fire Extinguishers. — The British Fire Prevention Committee, after an extensive series of investigations, to meet the danger of badly made liquid chemical fire extinguishers, the defects in which had resulted in fatalities, has issued a complete specification, which covers all points as to size, strength, precautions against bursting, directions for use, facilities for testing, &c., of importance in such appliances. The public are reminded that ordinary buckets of water (together with hand pumps) are equally, if not more, effective in the majority of cases, and further, have considerable economic advantages for ordinary purposes.

American Electrical Exports for October.—The following data regarding the electrical exports from the United States for the month of October are published by the American *Electrical Review and Western Electrician*. The total value of electrical shipments in October was less than 60 per cent. of that for the corresponding month of 1913; it also was slightly lower than the total for September, but considerably higher than the figure for August, the first war month. In the four classes for which numbers of articles shipped are reported, there were exported in October the following:—electric fans, 428; arc lamps, 359; carbon-filament lamps, 38,293; metal-filament lamps, 229,168. In the following table are given the detailed figures for the different classes for October of last year and of 1913:—

	Oct., 1914.	Oct., 1913.
Batteries	$69,061	$53,078
Dynamos or generators	131,286	245,569
Fans	6,684	26,582
Insulated wire and cables	144,906	304,561
Interior wiring supplies, &c. (including fixtures)	47,551	86,039
Lamps—		
Arc	9,846	2,820
Carbon-filament	4,625	23,715
Metal-filament	42 007	16,918
Meters and other measuring instruments	34,418	—
Motors	229,605	411 784
Static transformers	40,655	150,838
Telegraph instruments (including wireless apparatus)	9,451	3,910
Telephones	61,544	190 875
All other	660,150	999,726
Total	$1,494,792	$2,516,415

Educational Notes. — NORTHAMPTON POLYTECHNIC INSTITUTE.—At the annual presentation of prizes and certificates by Lord Moulton last month, in his report on the session's work, Dr. R M. Walmsley said that the reorganised system of evening education by the L.C.C. had deprived the Polytechnic of many junior students, but, on the other hand, the Post Office policy of improved staff education had added between 200 and 300 students to the classes in Technical Telegraphy and Telephony, theory and practice. The dearth of optical instrument makers was particularly serious at present, and made the completion of the new annexe especially desirable. All the engineering students had been placed in workshops during the summer vacation, or, in the case of certificated fourth-year students, had found favourable employment. About 250 students and members of the staff had joined the Colours, and the war had naturally reduced enrolments this session by several hundreds.

Lord Moulton said that his work as chairman of a special Board of Trade and Government Committee had shown him to what an extraordinary extent England had become industrially dependent on Germany. The time had gone by when industrial success depended on making the best of limited available scientific knowledge. There were now available stores of information on which it was possible to base definite policies with the certainty of success, and the country which best took advantage of such information would lead all others in industrial competition. To some extent England had undoubtedly fallen behind other countries, among them Germany, in securing and applying technical education, but given the realisation of the extreme importance of basing our own work on what was already known—and hence of voluntary devotion to preliminary study and labour—England could and must show that she was no more intellectually and industrially decadent than she was decadent in military prowess.

KING'S COLLEGE.—FACULTY OF ENGINEERING.—Next term begins on Wednesday, January 13th. Particulars are given in our advertisement pages to-day.

Legal.—CLAIM FOR ELECTRICAL GOODS.—In the City of London Court, on Tuesday, before Mr. Assistant Registrar Tattershall, a claim was made by Otto Bohndel, proprietor of Schoen Bros., electrical accessories manufacturers, 29, Cock Lane, against Messrs. S. H Lewin & Co., electrical engineers, 29, Walton Street, Chelsea, for the sum of £1 10s. 2d. for electrical switchblocks supplied. The defendant, Mr. Lewin, was said to have given the order for the goods to the plaintiff personally. The defendant, who was requested to cross-examine the plaintiff, said:—"We are perfectly well aware we owe the money, but these goods are made in Germany. We have had the pleasure of doing business with Schoen Bros. for 10 or 12 years, and I have paid their accounts." When the war started they received a demand for payment of the account, but to that he took exception, and as a patriotic Englishman, confided it to the waste-paper basket. They then had a letter from a debt collecting agency, but he gave instructions to his clerk to write across it "We object to pay, because we are patriotic. The goods were made in Germany, and I do not intend to pay unless the Registrar says we shall." They had been in business for 14 years, and they were one of the best firms, he supposed, in London. That was the first summons they had been served with. He had had the honour of sending seven men to Kitchener's Army. The Assistant Registrar: Life is short. We do not want a long address upon patriotism. You admit you have had these goods. The defendant: I do. The Assistant Registrar: Pay in 14 days. The Defendant: German made, Sir.

The Trade War.—The campaign which is being carried on in the *Evening News* against Germany's trade, on Monday dealt with "British Enterprise in Electrical Trades." The article contains a proportion of truth, but is, in the main, so ill-informed and inaccurate, that it is liable to produce very erroneous impressions on the mind of a layman. In particular, the statements which it makes regarding the private telephone manufacturing business are utterly nonsensical. The public are informed that before the war all the British private telephone companies bought their telephones from the Germans, but that two months after the war broke out a British engineer established "a factory where all the instruments required for the private telephone companies in this country could be manufactured." This piece of British enterprise is described as "distinctly encouraging." The author of these wild statements appears to be unaware of the fact that there are at least eight large telephone factories in this country, most of which have been established for many years, and that these are capable of producing all the private telephones required for our needs. He goes on to say that the same thing may be said in regard to metallic-filament lamps, which can be obtained of British make, "at prices which compare most favourably with those formerly made in Germany." The prices are exactly the same as before the war, and the lamps have been manufactured in this country on a very large scale almost from the commencement. In justice we must commend the last three paragraphs of the article, in which the writer points out that an enormous amount of the ratepayers' money has been paid for German electrical goods, which ought to have gone into the pockets of British workmen.

Of course, our readers know all about these facts, but it is a pity that the general public should be misled by the daily Press.

Blackpool Traders' Exhibition.—The electricity and tramways department took a very prominent position at the Exhibition which was held last month, and erected a very fine stand for the display of electric heating and cooking apparatus; the exhibit of electric light fittings was left to the electrical contractors, and five of the principal contractors in the town had stands close to what was known as the Corporation Electricity Bureau. The display of up-to-date electric cookers and fires was a very large one, most of the principal electrical manufacturers' products being shown.

The Corporation also conducted demonstrations and lectures twice daily, and the skilled operations of Mrs. Mole, M.C.A. (Gold Medallist) Principal, Eustace Miles School of Cookery, London, attracted large crowds; it is hoped that the result will be that many of the existing consumers will adopt the Corporation's new rateable value tariff of ½d. per unit. The total number of electric cookers and ovens on exhibition was 18, and there were no fewer than 108 electric fires. A considerable amount of literature was distributed, and the electricity department soon felt the benefit from the Exhibition, as the contractors installed during the past month something like 100 electric fires in the residences of consumers.

It is a settled policy on the part of the British Commercial Gas Association to introduce, on every occasion where possible, a counter-attraction to that of the electricity undertaking. This was obvious from the display which the gas department and the ironmongers in the town made at the Blackpool Exhibition, for some 56 gas ovens and 68 gas fires were exhibited. Steps were also taken to counteract the publicity campaign of the electricity department in the local Press; the latter department has for some time adopted a policy of this character, with the result that the revenue has gone up at the rate of £1,000 per quarter. The importance of carrying on an effective propaganda of this kind can hardly be over-estimated; the British Gas Association has set an admirable example, and it is most desirable that the electricity supply industry should co-operate on similar lines, and carry the war into the enemy's camp.

The activity of the gas department in challenging on every possible occasion the propaganda of the electricity supply is shown by the following incident:—Some months ago, Mr. Charles Furness, the borough electrical engineer, advocated in Committee the desirability of opening a showroom in a central part of the town for the display of electric heating and cooking apparatus, but without any intention whatever of selling direct to the consumer. His reason for this recommendation was that whereas every ironmonger in the town was an indirect agent for the gas department and displayed gas cooking apparatus for the information of the consumer, the electrical contractor in Blackpool was generally content with an office and had no facilities for the display of electric heating and cooking apparatus. The recommendation was adopted by the Committee, but immediately it was known that this department had taken a shop for the purpose of a showroom, the gas department came along with a similar resolution for premises adjacent to the electricity showroom.

To this Mr. Furness had no objection whatever, but when the matter came before the Council, both the resolutions were rescinded. There is no proof that the rescission was engineered by the local gas interests, but upon the face of things it looks suspicious.

The showroom scheme having been defeated, the only alternative for the electricity department is to be represented on every occasion in the local exhibitions, and to distribute in literature and publicity matter, at least what would have been spent in rent for the showroom.

Appointments Vacant.—Wireless telegraph operator (£250), for Government of St. Lucia; junior engineer-in-charge (£91); switchboard attendant (30s.), temporary, for Newport electricity department; switchboard attendant (30s.), for Plymouth electricity works; power station superintendent, over 25, for Maidenhead electricity works; shift engineer (£104) for Birmingham electric supply department; traffic superintendent (£150) for Darlington Corporation; mains assistant and shift engineer (35s.) for Radcliffe U.D.C.; chief assistant (£117), also shift engineer, for King's Lynn electricity works; junior shift engineer (30s), for Luton electricity works. Particulars are given in our advertisement pages to-day.

Radium Hospital.—The new radium laboratories of Manchester Infirmary, which contain radium of the value of £20,000, were formally opened last week by the Lord Mayor.

Inquiry.—A correspondent wishes to meet with a firm selling high-class second-hand electric light fittings.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Dublin Corporation, on Monday, appointed MR. EUGENE ALLAN, son of Mr. Fred. Allan, secretary of the Council's Electricity Committee, to the position of superintendent of public lighting, city gas examiner and official meter tester, at a salary of £200 per annum, rising by annual increments of £20 to £300. Mr. Mark Ruddle, city electrical engineer, had reported that Mr. Allan's testimonials showed him to be well qualified for both gas and electrical sections. Mr. Allan secured 43 votes against 19 given for the next candidate. A motion to have the position re-advertised on the ground that the letter describing the qualifications of the 10 candidates assured the Council that nine were not qualified, was rejected by 54 votes to 13, and a further motion for the rejection of Mr. Ruddle's report was defeated by 41 votes to 17.

MR. A. J. BECKETT, borough electrical engineer at Bridlington, has received a commission in the engineering branch of H.M. service. The T.C. has granted him leave of absence, and appointed MR. F. FFRENCH as deputy electrical engineer.

MR. H. G. WRIGHT has been appointed temporary assistant mains engineer at the Dover electricity works.

MR. J. COLLINGE has been appointed to the position of station superintendent at the Salford electricity works at his present salary.

Will MR. WILLIAM ROZE, recently junior engineer-in-charge in the Belfast Corporation electricity department, communicate with Mr. A. Nichols Moore, borough electrical engineer, Town Hall, Newport, Mon.?

MR. A. HELLEWELL, of Govan, has been appointed shift engineer at the Eccles electricity works. MR. KING, of Newcastle-on-Tyne, has been appointed temporary shift engineer.

General.—The marriage took place at the Parish Church, Knaresborough (Yorks.), on December 29th, of MR. ARTHUR R. FARRAR, of the firm of Farrar & Co., electrical engineers, of Bradford, and Miss Fearnside, elder daughter of Mr. Fearnside, of Yorke House, Knaresborough.

MR. OSBORNE, assistant telegraph superintendent for the Tonbridge Postal District, who has retired after 50 years' service, has been presented by the staff with a gold watch.

MR. H. FOUNTAIN, C.M.G., has been appointed Assistant Secretary to the Commercial Department of the Board of Trade, in the place of Mr. G. J. Stanley, C.B., C.M.G., retired. Mr. Stanley continues to assist the Board in an advisory capacity.

The *Times* states that the marriage of MR. O. W. F. LODGE, eldest son of Sir Oliver Lodge, to Winifred, only daughter of Dr. W. N. Atkinson, H.M. Inspector of Mines, took place on December 31st at St. John's, Cardiff.

MR. C. F. MACKNESS has resigned the appointment which he has held for the last 11 years as manager of the London office of the A.E.G. Electrical Co. of South Africa, Ltd. (late agents for the A.E.G. of Berlin, Foreign Department), and has joined the staff of Messrs. Vickers, Ltd., London, as assistant manager of the electrical department, as from the 1st inst.

We tender our congratulations to MR JOHN COWAN, the founder of the Stirling Boiler Co. in this country, and who has been its chairman since its inception, upon the honour of Knighthood, conferred upon him in the New Year's List. MR. E. G. CONSTANTINE, who has been associated with the company for many years, has retired from active business and resigned his position as managing director, remaining, however, a director of the company. He is succeeded in the management by MR. H. J. S. MACKAY.

MR. H. L. AINSWORTH has resigned his position as head representative to Messrs. J. & H. Grevener, of London, and has joined the British Thomson-Houston Co., Ltd., as representative for London to their wiring supplies department.

Obituary.—We regret to learn that MR. GEORGE STEGMAN, principal in the firm of Stegman & Co., Clapham Junction, passed away on Tuesday, December 22nd, after a long and severe illness. The business will be carried on as usual.

The sudden death of MR. JOHN HOUISON, engineer, Methil, who had been in charge since the opening of Methil Dock, of the power department, is reported.

NEW COMPANIES REGISTERED.

Pullan Engineering Co., Ltd. (138,851).—This company was registered on January 1st, with a capital of £3,000 in £1 shares, to take over the business of an electrical engineer and merchant carried on by C. Pullan at 80, King's Arcade, Bradford. The subscribers (with one share each) are: G. Pullan, 80, King's Arcade, Bradford, electrical engineer; C. H. Best, 72, Market Street, Bradford, incorporated accountant. Private company. The number of directors is not to be more than five; the first are C. Pullan, H Best, V. Learoyd, and W. Myers. Qualification, 25 ordinary shares. Remuneration as fixed by the company. Registered office: 80, King's Arcade, Bradford.

B. T. Gardner and Co., Ltd. (138,839).—This company was registered on January 1st, with a capital of £1,000 in £1 shares, to take over the business of electrical engineers and contractors carried on by B. T. Gardner & Co. at 6, Fox Court, Holborn, W.C., and to adopt an agreement with B. T. Gardner. The subscribers are: B. T. Gardner, 44, Royston Avenue, South Chingford, electrical engineer, 5 shares; H. Boocock, 23, Bryanstone Road, Crouch End, N., shopfitter, 10 shares; D. J. Gaillard, 50, Crookham Road, Parsons Green, S.W., electrical engineer, 5 shares. Private company. The number of directors is not to be less than two or more than five; the first are B. T. Gardner, H. Boocock and D. J. Gaillard. Solicitors, Needham & Barrow, 34, Essex Street, Strand, W.C. Registered office: 6, Fox Court, Gray's Inn Road, W.C.

Devon and Cornwall Acetylene Co., Ltd. (138,842).—This company was registered on January 1st, with a capital of £500 in £1 shares, to experiment with and exploit any chemical and electro-chemical processes, to manufacture and deal in carbide of calcium, ferro-alloys, oxygen and similar products, to carry on business as electricians, manufacturers of electrical and mechanical plant, etc. The subscribers (with one share each) are: C. Bingham, 11, Queen Victoria Street, E.C., merchant; A. S. Young, 11, Queen Victoria Street, E.C., merchant. Private company. The number of directors is not to be less than two or more than seven; the subscribers are to appoint the first. No qualification necessary. Remuneration as fixed by the company. Registered office: 223, Mansion House Chambers, 11, Queen Victoria Street, E.C.

Strand Electric Supply Co., Ltd. (138,813).—This company was registered on December 30th, with a capital of £6,000 in 400 cumulative preference shares of £5 each, 1,500 preferred ordinary and 2,500 ordinary shares of £1 each, to carry on the business of an electric lighting and power company in all its branches. The subscribers (with 50 shares each) are: A. A. Douglas, Brandon, Colwyn Bay, manufacturer; J. Herbert Edwards, Haresfield, Stonehouse, Glos., engineer. Private company. J. Herbert Edwards is the first managing director. Qualification, 50 shares. Solicitors, Seymour Williams & Co., 38, Parliament Street, Westminster.

Electro Galvanizers, Ltd. (138,767).—This company was registered on December 24th, with a capital of £20,000 in £1 shares (12,000 first pref., 5,000 second pref., and 3,000 ord.), to carry on the business of engineers and contractors, galvanisers, inlayers of metals, electro-platers of metals and other substances, metallurgists, metal workers, electro chemists, etc., and to adopt an agreement with W. G. Elliott. The subscribers (with one share each) are: H. E. G. Jarvis, 25, Ely Place, Holborn Circus, E.C., articled clerk; H. Handley, 4, Cromwell Road, Walthamstow, clerk. Private company. The number of directors is not to be less than two nor more than five; the first are D. Livingston and W. G. Elliott (both permanent). Qualification, 100 shares. Remuneration (except managing director), £100 each per annum and a percentage of the profits. Registered office: 18, St. Swithin's Lane, E.C.

Wadebridge and District Electric Supply Co., Ltd. (138,776).—This company was registered on December 24th, with a capital of £3,450 in £1 shares (1,250 six per cent. pref.), to carry on the business of electric light and power producers and suppliers, gasworks owners, electrical engineers, supply agents for electrical goods, etc., and to enter into an agreement with C. D. Minns, of Obnassi, Gold Coast Colony, West Africa. The subscribers (with one share each) are: C. E. Hannoford, The Cottage, Felbridge, East Grinstead, artist; A. Wright, Station Road, Sidcup, Kent, electrical engineer; W. Phillips, Court Place, Wadebridge, Cornwall, land owner. Private company. The number of directors is not to be less than two or more than five; the first are C. E. Hannaford, A. Wright, and W. Phillips. Qualification, 50 shares. Registered office: 1, Flora Place, Wadebridge, Cornwall.

Bedale and District Electric Supply Co., Ltd. (138,794).—This company was registered on December 29th, with a capital of £3,000 in £1 shares (2,000 pref.), to carry on at Bedale, Yorks, or elsewhere in the United Kingdom, the business of proprietors of an electric light undertaking. The subscribers (with one share each) are: C. H. Best, 72, Market Sereet, Bradford, incorporated accountant; R. W. Smith, 4, The Villas, Bedale, electrical engineer; W. Metcalfe, Elmwood House, Leeming Bridge, Bedale. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. The holders of the pref. shares have the right to appoint two directors, except when the total number in office does not exceed three, when one shall suffice to represent such shareholders. Qualification, £25. Remuneration as fixed by the company. Registered office: 72, Market Street, Bradford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Telephone Development Co. (1912), Ltd. (121,272).—Capital £250,000 in £5 shares. Return dated July 24th, 1914. 44,540 shares taken up; paid £222,700. Mortgages and charges, nil.

Universal Electric Contracts, Ltd.—Mortgage debenture, dated 19th December, 1914, to secure £600, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: G. E. Corfield, Balfour House, Finsbury Pavement, E.C.

Rhondda Tramways Co., Ltd.—A memorandum of satisfaction to the extent of £2,500 on various dates from 16th April to 22nd Dec., 1914, of charges dated 24th March, 1911, and 13th Nov., 1912, securing £240,000, has been filed.

North-Eastern Electric Smelting Co., Ltd.—A memorandum of satisfaction in full on 21st December, of mortgage debentures dated 17th August and 8th October, 1914, securing £500 and £130 respectively, has been filed.

Julius Sax and Co., Ltd.—Capital £18,000 in £1 shares. Return dated October 30th, 1914. All shares taken up; £12,005 paid; £5,995 considered as paid. Mortgages and charges, £2,500.

Stearn Electric Lamp Co., Ltd.—Capital £4,070 in £10 shares. Return dated August 11th, 1914. All shares taken up; £70 paid; £4,000 considered as paid. Mortgages and charges, nil.

CITY NOTES.

The Siemens-Schuckert Group of Companies.

The Rhenish-Schuckert Co.

The directors of the Rhein Schuckert Gesellschaft fur Elektrische Industrie of Mannheim, as in the case of certain other companies, report that the balance-sheet for 1913-14 has been carefully prepared, having regard to the present state of affairs. After setting aside £25,000, as in 1912-13, as reserve fund for investments, and making other appropriations, the accounts show net profits of £56,000, as compared with the same amount in the preceding year. The dividend proposed is at the rate of 5 per cent. on share capital of £400,000 and at 2½ per cent. on new capital of £1,500,000; the sum of £10,000 has been placed to the extraordinary reserve fund, as in 1912-13, and £5,000 to the pension fund, leaving £18,000 to be carried forward, as against £17,000 in the previous year. Besides being interested in a number of undertakings, the company carries out constructional work, and the directors state that they hope to be able to continue this work with the diminished staff now available.

The Schuckert Electricity Co.

The report of the Elektrizitats A.G. vorm. Schuckert Co., which has been merely an investment company for some years past, and which is joint proprietor with the Siemens and Halske Co. in the Siemens-Schuckert Works, states that the company's own undertakings and those in which it is also financially interested experienced satisfactory results in the year ended with July 31st, 1914. The general backward movement in trade which had been occasioned by the warlike complications in the Balkans had reached a standstill, and the directors therefore would have proposed a dividend of at least the same amount as in 1912-13 if a new situation had not been created by the outbreak of the world-war at the beginning of the new financial year. Having regard, however, to the state of war, they had estimated the assets in a particularly careful manner and recommended a dividend of 6½ per cent. as compared with 8 per cent. in the previous year. The report proceeds to state that the influence of the war would naturally also be felt in connection with the company's undertakings in the present financial year. It had been possible everywhere to maintain the working and to continue the execution of extensions of supply stations, especially as a greater demand for electrical energy was being manifested in order to economise the stocks of petroleum. The company had participated in the formation of the Nuremberg War Credit Bank, in the subscription to the National War Loan, and in various benevolent funds in connection with the war, and had made provision for the families of employés who had been called to the colours. After giving details of the manufacturing and other investments in different countries, the report sets forth the following figures:—

	1913-14.	1912-13.
Share capital	£3,500,000	£3,500,000
Loan capital	2,365,000	2,215,000
Gross profits	412,000	484,000
General expenses	25,000	22,000
Interest on loans	103,000	84,000
Depreciation	700	700
Net profits and balance forward	304,000	364,000
Allocation to special reserve fund	—	5,000
Dividend	227,000	280,000
Dividend, per cent.	6½	8
Carried forward	66,000	63,000

The reserve fund is returned at £485,000 and the special reserve fund at £50,000. The holding in the Siemens-Schuckert Works remains at £2,247,500 for the ordinary capital and at £1,250,000 for the perpetual 6½ per cent. loan advanced by the two proprietary companies.

The Siemens & Halske Co.

The report of Siemens und Halske A.G. for the year ended on July 31st, 1914, states that the year terminated on the eve of mobilisation, and the working results, therefore, were not directly affected by the influence of the war. In general, the year had the character of increasing improvement. But, on the other hand, the accompanying phenomena of the war which had arisen in the meantime and the unknown developments of the future rendered necessary a specially careful examination of the list of assets in the balance-sheet. It had been emphasised for years past that particular care had been taken in this direction, but for the past year the company went beyond the usual measure, and also proposed to reduce the dividend from 12 to 10 per cent. In this way it was believed that the company would appropriately meet the various points of view which concerned the question of the computation of the dividend. The permanent investments in foreign companies, partly situated in hostile countries, stood in the books at amounts which also took into account the risks existing in time of war. It was obvious in a period of serious economic convulsion like that caused by the war that the electrical industry was considerably involved, because its manufacturers were to a large extent of the kind through the employment of which greater perfection in economy was obtained, but in war time requirements of that nature were only on hand to a smaller degree. As a consequence, the orders received by the works for articles of peace in the new financial year were considerably below the average of the corresponding period in previous years. As, however, the company from the beginning had occupied itself very fully with the requirements of the Army and the Navy in the matter of electrical equipment, and had participated in the development of new branches, an assured compensation was offered in the new spheres of work for the slacker activity in peace manufactures. In addition, the plant had been accommodated as much as possible to further military needs and had been placed at disposal. At the time of the report being printed the staff of the firm and of the Siemens-Schuckert Works had contributed to the colours 3,588 officials and 9,938 workmen, or a total of 13,526 men. The directors expressed the belief that they might abstain on the present occasion from reporting on the technical development which had taken place, except to mention that it had proceeded systematically in the usual manner and been successful. The accounts are given below:—

	1913-14.	1912-13.
Ordinary share capital	£3,150,000	£3,150,000
Loans	2,216,000	2,242,000
Gross profits	661,000	733,000
General expenses	49,000	54,000
Interest on loans	94,000	95,000
Depreciation	20,000	21,000
Net profits and balance forward	557,000	625,000
Special reserve fund	100,000	100,000
Disposition fund	25,000	25,000
Bonuses	45,000	45,000
Dividend	315,000	378,000
Dividend, per cent.	10	12
Carried forward	60,000	60,000

Siemens-Schuckert Works.

The directors report that the year 1913-14 developed better than might have been expected from the indications of a general decline in trade prosperity, and consequently the orders received were not inferior to those of the preceding year. During the twelve months the German works delivered 128,267 machines, motors and transformers of a total of 2,849,582 KW., as compared with 132,800 and 2,990,000 KW. in the previous year respectively. The time following the day of mobilisation on August 1st at first brought about stagnation in the course of economic activity, and in the early days of that month 1,602 officials and 6,081 workmen were called up, the number rising to 2,327 and 7,102 respectively by the middle of November. At present the staff corresponded with the extent of the orders received in consequence of the increased employment for the requirements of the Army and Navy. The company, in conjunction with the Siemens & Halske Co., participated with corresponding amounts in the War Credit Bank of Greater Berlin as well as in the Nuremberg War Credit Bank in association with the Electricity Co. (late Schuckert) of Nuremberg, and also in the War Metal Co. and other undertakings of public utility in accordance with the circumstances of the times. The active trade with the company's friendly houses in England, France and Russia had naturally been tied up through the war. Oversea trade, which had been of considerable extent, was also very difficult, but the directors ventured to have confidence that the victorious termination of the war would lead to increased prosperity in this branch of business activity. It was obvious that prudence rendered necessary a specially cautious calculation of the balance-sheet, which was possible thanks to the favourable results for the year. The accounts exhibit the following figures:—

	1913-14.	1912-13.
Ordinary capital	£4,500,000	£4,500,000
Loans (obligations)	3,877,000	3,905,000
Perpetual 6½ per cent. Loan	2,500,000	2,500,000
Gross profits	1,063,000	1,167,000
General expenses	94,000	94,000
Interest on loans	337,000	333,000
Depreciation	74,000	62,000
Net profits and balance forward	574,000	692,000
Allocation to reserve fund	125,000	125,000
Bonuses to staff and workmen	75,000	75,000
Provident fund	25,000	25,000
Profit share of the two proprietary firms	337,000	450,000
Percentage of profit distribution	7½	10
Carried forward	12,000	17,000

During the year the company's technical work showed quiet but constant development. In particular, attention was paid to the improvement of the methods of working, to reconstructions which were shown to be requisite in consequence of the new regulations of the Union of Electrical Engineers, and to the standardising and development of the branches which aim at the protection of electrical installations in connection with the increasing employment of high-tension currents. The company's activity for the mining

industry, which was in a difficult situation, especially in regard to the potash industry, experienced an increase through the large advance in orders for winding engines for abroad, and the foreign orders for the iron industry also provided as great employment as in the previous year. No material change occurred in all other industries as contrasted with 1912-13. The extension of existing overland stations and the establishment of new works continued to follow an active course. As a matter of technical interest, the report mentions the central station at Zug, Saxony, which utilises water power and is situated at a depth of 1,000 ft. in a disused mine, the output being 2,400 KW. The experimental installations in progress for various administrations in regard to main line, city and suburban railways, were approaching completion. The trial runs on the main electric line between Kiruna and Riksgränsen in Sweden had begun, the railway being intended for the working for the first time in Europe of goods trains of over 2,000 tons, for the transport of iron ore. Owing to the war it was impossible to bring into operation by the pre-arranged time the almost completed sections between Halle, Leipsic and Bitterfeld and the Silesian mountain section between Laubau and Konigszelt, together with the auxiliary sections. In the case of South German lines, sections had been brought into operation with direct current at 1,200 volts with good success. The transmarine business was in a state of depression during the year in consequence of a reduced influx of European capital, disturbed political conditions, economic failures in regard to finance, unfavourable harvests, and the course of prices for important export commodities. As further technical progress are cited the facts that the large three-phase transformers, each of 23,000 KW., ordered in 1912-13, for 25,000 volts had well stood the test in working, and a similar remark was applicable to the Lauchhammer station, which was working at 110,000 volts. Other installations for the same high pressure were either carried out or placed on order, as, for instance, the Neuss station, the Palatinate station, as well as essential instalments for the Murg power station of the Bavarian Government, whilst 31 miles of cable for 50,000 volts were supplied to Spain. Direct-current turbo-generators were constructed at 3,000 revolutions to 1,000 KW.; three-phase turbos at 1,500 revolutions to 15,000 KW., and at 1,000 revolutions to 30,000 KW.; water-power generators at 214 revolutions to 12,000 KW.; converters and three-phase motors at 375 revolutions to 5,000 KW., and potential regulators to 20,000 KW., which is probably the largest so far employed.

Tata Hydro-Electric Supply Co., Ltd.—It appears from the recently issued fifth report that the whole of the company's available supply of power has been already disposed of, and that 35 cotton and three flour mills have contracted for such supply for a period of 10 years. The report gives a very satisfactory account of the progress of the work. The dam and other works of the Lonavla Lake are sufficiently forward for practically full storage and use, and the same, to all intents and purposes, may be said of the Walwhan Lake dam. The duct from Lonavla Junction to the forebay is sufficiently advanced to carry 3 ft. of water for beneficial use, and this water can be delivered as soon as the pressure pipe-line is completed. The Walwhan duct is not so far advanced, but the forebay dam and bed of the basin are sufficiently completed to enable the forebay to be filled to 10 ft. above the outlet level. The work on the pipe-line still appears to be the most backward, and in this respect very different to that in connection with the power house, where, it seems, power could be generated any time if water were available at the turbines. All the transformers required for the original installation are reported on the site. Complete motor equipments have been delivered for 19 mills, and partial deliveries have been made for several others. Work on cables, switchgear, meters, &c., is also well in hand. Thus it appears that there will be no difficulty in utilising current when once the supply begins.—*Indiaman.*

Nairobi Electric Power and Lighting Co., Ltd.—It is reported that the war has not yet affected adversely the company's working at Nairobi, and that there is no reason for uneasiness. The directors have, therefore, decided to make an immediate further distribution of profits by declaring a second interim dividend for the year 1914, making 6 per cent. now paid on both the preference and ordinary shares, and they hope that when the year's accounts are completed and audited, there may be sufficient profit shown to warrant a final substantial dividend in respect of the year's working.

Delabole Electric Lighting and Supply Co., Ltd.—The first annual meeting was held on December 31st, but no statement of accounts could be presented. Mr. M. J. Wills, the chairman, said that the secretary had been away serving his country, and the assistant secretary had been unwell. The meeting was adjourned to January 18th.

Mexican Electric Light and Tramway Companies.—Owing to the continued unsatisfactory condition of affairs in Mexico, payment of the half-yearly coupon now due on the 6 per cent. 50-year mortgage bonds of the Mexican Tramways Co. is deferred, as is also payment of the half-yearly coupon of the 5 per cent. first mortgage gold bonds.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the five weeks ended October 30th, 1914, were 1,464,381 compared with 1,426,639 in the corresponding five weeks of 1913. For the four weeks ended November 27th the units delivered amounted to 988,840, compared with 965,848 in 1913.

City of London Electric Lighting Co., Ltd.—Warrants in payment of the half-year's interest to December 31st less income-tax at 1s. 10d. in the £ on the first and second debenture stocks, have been duly posted.

STOCKS AND SHARES.

Tuesday Evening.

THE Stock Exchange re-opened its doors last Monday, January 4th, for the first time since they were closed on Friday morning, July 31st, 1914. Notwithstanding the serious nature of the restrictions imposed by the Treasury as the price which the House has to pay for being allowed to conduct business within its own doors, members were unfeignedly glad to get back to their accustomed positions. Veterans who had not been seen in Throgmorton Street for many a year put in an appearance on this historic occasion. For the first time since Maurice Gifford and a party of Rhodesian Horse crossed the Kaffir Circus after the Boer War, men in khaki mingled with groups of their fellow-members who appeared in every-day clothes. The occasion tingled with keen excitement, suppressed nominally, but very apparent actually—to those who know the markets—in the high boisterousness of spirits which prevailed.

It might have been thought that members were returning to the pleasantest of business prospects, instead of coming back to chains and fetters provided by the Treasury for every bargain done. The fear is that alien enemies may take advantage of the Stock Exchange being officially open, and realise money which might be transmuted into guns and ammunition whereby the war might be lengthened and more lives sacrificed. The Treasury, moreover, views with lively apprehension the possibility of outside raids being organised against British credit, through the medium of bear operations in the Stock Exchange markets. These are the principal reasons why they have shackled Stock Exchange business with such impediments as to make House men despair of paying expenses for a long time to come, unless the conditions are modified.

The Stock Exchange sang the National Anthem with profound feeling and fervour; at the line "And make them fall," the domes reverberated with the force sung into the words. And when three rousing cheers were given for the King at the end of the brief ceremony, many members found themselves obliged to retire abruptly behind convenient pillars and telephone rooms, in order to swallow quite unusual sensations which persisted in arising in their throats.

Business is now on a purely investment basis. During those five months that lay between August and December, a certain amount of speculative buying and selling went on which now is no longer possible. The man who sells shares must, in giving the order, provide the name of the transferor and the distinctive numbers. The certificate must have been in physical possession within the United Kingdom for at least three months. The client, be he buyer or seller, has to sign a declaration to the effect that the transaction is not on behalf of an alien enemy, directly or indirectly. In exceptional cases, transactions may be carried through for clients outside the United Kingdom; but everything of this sort is subject to the keenest scrutiny, and must be submitted to the Stock Exchange Committee before it is allowed.

There should be now no difficulty experienced by the buyer in obtaining delivery of stock or shares, for the jobbers are precluded from selling short, even where they have the reasonable certainty of replacing stock at a profit. Every bargain has to be officially recorded, whether it be in quoted or unquoted securities. The Stock Exchange Official List has made its re-appearance in guise most unfamiliar. Not all markets, it should be added, are hampered by the imposition of a scale of minimun prices below which members are not allowed to deal. So far as the electrical issues are concerned, this restriction applies only to certain securities in the Home Railway lists. The Treasury, however, retains the right to extend the principle of medium prices as and when it considers such conditions needful.

Those clients who find such bars to business to be irksome and cumbrous will be the more ready to sympathise with the Stock Exchange broker who is obliged to deal only in this way, because of the Treasury requirements. The prophetic optimist foresees early modification of the restrictions, though the paternity of the wish renders it suspect.

The Metropolitan Railway issue of 5 per cent. Preference stock failed to achieve the same measure of success as attended those previously made by the London and South-Western and the South-Eastern Companies. The security was regarded as somewhat less attractive than that offered by the other two railways; whereas premiums are established in the case of the latter stocks, the new Metropolitan Preference stands at a discount of about 1½ per cent.

Home Railway stocks, as a whole, are not at all bad, expectation looking for maintenance of much the same dividends as those which were paid a year ago. The Underground group, however, is exceptional, and prices are heavy. It will be observed from the

following list that small falls have taken place this week in three or four cases. We have added to our usual prices another column showing the levels at the end of July, when the Stock Exchange closed :—

	Mean price, July 27.	Jan. 5, 1915. Now.	Rise or fall this week.
HOME ELECTRICITY COMPANIES.			
Brompton Ordinary	9⅜	8⅞	—
Do. 7 per cent. Pref.	8⅝	8⅝	—
Charing Cross Ordinary	5¼	4⅞	—
Do. do. do. 4½ Pref.	4¾	4¼	—
Do. do. City Pref.	4⅜	4	—
Do. 4 Deb.	91½	88	+ 1
Chelsea	4⅝	4⅜	—
Do. 4½ Deb.	96½	91½	—
City of London	16	14⅞	—
Do. do. 6 per cent. Pref.	13⅛	13	—
Do. do. 5 Deb.	116½	114	—
Do. do. 4½ Deb.	100¼	98	—
County of London	12	11⅞	—
Do. do. 6 per cent. Pref.	12	11¾	—
Do. do. 1st Deb.	102½	99	—
Do. do. 2nd Deb.	10⅝	97	—
Kensington Ordinary	7⅞	7⅞	—
London Electric	1 7/16	1¼	—
Do. do. 6 per cent. Pref.	5 1/16	5	—
Do. do. 4 Deb.	92½	87½	—
Metropolitan	3⅛	3⅛	—
Do. 4½ per cent. Pref.	4 7/16	4¼	—
Do. 4½ Deb.	97⅛	91⅛	—
Do. 3½ Deb.	88	81½	—
St. James' and Pall Mall	9⅝	9	—
Do. do. do. 7 per cent. Pref.	7	6¾	—
Do. do. do. 3½ Deb.	81½	83	—
South London	3 1/16	8	—
South Metropolitan Pref.	1¼	1¼	—
Westminster Ordinary	8⅝	8⅜	—
Do. 4½ Pref.	5⅞	4⅞	—
TELEGRAPHS AND TELEPHONES.			
Anglo-Am. Tel. Pf.	108¼	102½	— 1½
do. Def.	23	21¾	— ¼
Chile Telephone	7⅜	7	—
Constantinople Tel.	4¼	4	—
Cuba Sub. Ord.	8½	8½	—
do. Pf.	16½	15⅝	—
Eastern Extension	12⅜	12	—
do. 4 Deb.	97½	94	—
Eastern Tel. Ord.	130½	121	+ 1
do. 3½ Pf.	77½	71½	— 4½
do. 4 Deb.	96¼	95	—
Globe Tel. and T. Ord.	11¼	10	— ⅞
do. Pf.	12¾	12¼	— ¼
Gt. Northern Tel.	32½	28	— 3½
Indo-European	59	57	— 1
Marconi	1 1/16	1⅛	+ 1/16
New York Tel. 4½	101	96	—
Oriental Telephone Ord.	2 5/16	2	—
do. Pf.	1 3/32	1 7/16	—
Tel. Egypt Deb.	98	97	—
United R. Plate Tel.	6⅜	6	—
do. Pf.	5¼	5	—
West India and Pan.	1½	1⅜	—
Western Telegraph	13⅜	12⅝	—
do. 4 Deb.	96½	95½	—
FOREIGN TRAMS, &c.			
Anglo-Arg. Trams, First Pf.	4⅞	4⅞	—
do. 2nd Pf.	4½	4⅜	—
do. 4 Deb	91	88½	—
do. 4½ Deb.	98½	96	—
do. 5 Deb.	96	89	—
Brazil Tractions	66	67½	— ½
Bombay Electric Pf.	11⅜	10½	— ½
do. 4½ Deb.	96	95	— 2
Mexico Trams.	70	45	—
do. 5 per cent. Bonds	84	70	—
do. 6 per cent. Bonds	76	65	—
Adelaide Sup. 6 per cent. Pf.	5¼	5 1/16	—
do. 5 Deb.	104	100xd.	—
HOME RAILS.			
Central London, Ord. Assented	83	79	+ 1
Metropolitan	37½	31	— ¼
do. District	21⅜	18	— ⅛
Underground Electric Ordinary	2⅝	1⅝	— ⅛
do. "A"	7/9	6/-	— 3d.
do. Income	88	79	— 1
MANUFACTURING COMPANIES.			
British Westinghouse Pref.	1⅝	1⅞	— ⅛
do. 4 Deb.	74½	72	—
do. 6 p. lien	102½	98	—
Callenders	11⅞	11½	—
do. 5 Pref.	5¼	4⅞	—
do. 4½ Deb.	98½	97⅝	—
Castner-Kellner	2 3/16	2 1/16	— ⅛
Edison & Swan, £3 pd.	2 3/32	18/-	+ 1/-
do. do. fully paid	1¼	2⅛	—
do. do. 4 Deb.	59	60	—
do. do. 2 Deb.	62½	60	—
Electric Construction	2 7/16	10/-	—
do do. Pf.	1 3/16	1	—
Gen. Elec. Pf.	10¾	10	—
Henleys	15	13	—
do. 4½ Pref.	5	4¾	—
do. 4½ Deb.	100½	97	—
India-Rubber	9	8½	—
Telegraph Con.	38½	36	— ½

c The Calcutta Electric Supply Corporation is offering its shareholders new Ordinary shares at 5½ and new Preference at 5. Application must be made for an equal number of both classes of shares. At the end of last July the offer would have been a very tempting one, because Calcutta Ordinary were standing at 7½ and the Preference at 5⅛. The war has brought prices down, and at the present time the nominal quotations are about 6 and 4¾ respectively, or £10 15s. together, so there is not much plunder to be made by subscribing at £10 10s. for the two. Moreover, no Stock Exchange dealings are allowed in any new issue made after January 4th, 1915, unless specially allowed by the Committee and approved by the Treasury. The company, however, has a fine record from 1900 onwards, so proprietors will probably take up their new shares as good investments.

Manufacturing issues are fairly steady, though Westinghouse Preference and Telegraph Constructions show falls on the week. Edison & Swan partly-paid shares are 1s. higher at 13s., and have been up to 14s. That the Company is doing extremely well with its lamp business has been common knowledge for some time past, and rumour now has it that substantial contracts for work in connection with submarines have been secured.

The Bill has been deposited for introduction into Parliament next session for constituting a company with powers to supply electrical energy in the County of London and adjacent areas. It is proposed to incorporate a company, with a share capital of six million pounds sterling, with borrowing powers of another two million pounds, and some see in this the possible advent of that Electric Supply Board—on the lines of the Metropolitan Water Board—which has been the dream of many people for years. The electric lighting market exhibits no important changes on the week, but there may be significance in the renewed eagerness of the demand that is noticeable for all the best Debenture stocks in this group.

MARKET QUOTATIONS.

OWING to the war, the prices given below are, of course, more or less nominal.

Wednesday, January 6th.

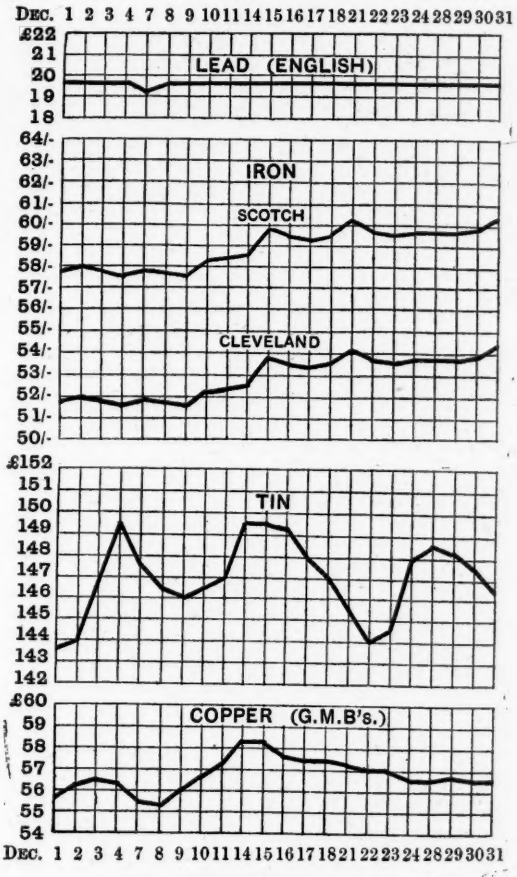
CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	4/6	..
a ,, Nitric	,,	19/-	..
a ,, Oxalic	per lb.	8d.	..
a ,, Sulphuric	per cwt.	5/-	..
a Ammoniac Sal	,,	£49	..
a Ammonia, Muriate (large crystal)	per ton	£49	..
a Bleaching powder	,,	£8 10	..
a Bisulphide of Carbon	,,	..	..
a Borax	,,	£18 10	..
a Copper Sulphate	,,	£20	..
a Lead, Nitrate	,,	£30	..
a ,, White Sugar	,,	..	..
a ,, Peroxide	,,	..	..
e Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	7d.	..
a Potash, Caustic (88/90 %)	per ton	..	..
a ,, Chlorate	per lb.	1/2	6d. inc.
a ,, Perchlorate	,,	8d.	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	,,	Nom.	..
a Shellac	per cwt.	55/-	..
z Sulphate of Magnesia	per ton	£8	£4 dec.
a Sulphur, Sublimed Flowers	,,	£11 10	..
a ,, Recovered	,,	£4	..
a ,, Lump	,,	£8 10	..
a Soda, Caustic (white 70/72 %)	,,	£'0 2 6	..
a ,, Chlorate	per lb.	8d.	1d. inc.
a ,, Crystals	per ton	45/-	..
a Sodium Bichromate, casks	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£85	..
b ,, Wire, in ton lots (1 to 14 S.W.G.)	,,	£112	..
b ,, Sheet, in ton lots	,,	£112	..
p Babbitt's metal ingots	,,	£50 to £221	..
c Brass (rolled metal 2" to 12" basis)	per lb.	8¼d.	..
c ,, Tube (brazed)	,,	9¾d.	..
c ,, ,, (solid drawn)	,,	8¾d.	..
c ,, Wire, basis	,,	8¾d.	..
c Copper Tubes (brazed)	,,	10¼d.	..
c ,, ,, (solid drawn)	,,	10¼d.	..
g ,, Bars (best selected)	per ton	£78	..
g ,, Sheet	,,	£78	..
g ,, Rod	,,	£78	..
d ,, (Electrolytic) Bars	,,	£61 10	..
d ,, ,, Sheets	,,	£79 10	..
d ,, ,, Rods	,,	£67 10	..
d ,, ,, H.C. Wire	per lb.	8 7/16d.	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	1 8	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	2/9½	½d. dec.
l Iron Pig (Cleveland warrants)	per ton	73/6	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£16	..
g Lead, English Pig	,,	£19 15 0	..
m Manganin Wire No. 28	per lb.	..	..
g Mercury	per bot.	£11 5 0	..
e Mica (in original cases) small	per lb.	4d. to 2/6	..
e ,, ,, medium	,,	6/- to 5/-	..
e ,, ,, large	,,	6/6 to 10/6 & up.	..
o Nickel, sheet, wire, &c.	,,	Nom.	..
p Phosphor Bronze, plain castings	,,	1/1 to 1/3½	..
p ,, ,, rolled bars & rods	,,	1/0½ to 1/6	..
p ,, ,, rolled strip & sheet	,,	1/2½ to 1/6½	..
o Platinum	per oz.	186/-	..
d Silicium Bronze Wire	per lb.	10½d.	..
r Steel, Magnet, in bars	per ton	£65	..
g Tin, Block (English)	,,	£154 to £156	..
n ,, Wire, Nos. 1 to 16	per lb.	2/4	..
p White Anti-friction Metals	per ton	£44 to £194	..
k Zinc, Sh's (Vieille Montagne bnd.)		Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

METAL MARKET.

Fluctuations in December.



Russia's Copper Production.—The output of copper in Russia has increased considerably in recent years, and if the rate of expansion which has taken place hitherto is maintained it would appear that the country will become independent of external supplies in the course of a few years, unless the demand increases in a greater ratio than the output. As the position is at present, the only material imported is said to be electrolytic copper, although the production of this quality was begun in Russia by the Rosenkrantz works in 1907, and was followed by the Kyshtym works in 1911. The development of the copper industry, as a whole, is illustrated by the fact that the imports declined from 20,300 tons in 1904 to 6,100 tons in 1913, whereas the native production increased by over three times in the same years to 34,300 tons in 1913. The Caucasus was responsible for 10,000 tons of the output in 1913, the Urals for 17,300 tons, Siberia for 5,700 tons, and the remainder of Russia for 1,300 tons. Most of the copper producers formed themselves into a syndicate (Medj) in 1907, and the accession of new members raised the quantity controlled by the syndicate to 95·7 per cent. of the total production in Russia in 1913. The great development of the industry is attributed to the systematic management of the syndicate, whose prices, in contradistinction to the South Russian Coal and Iron and Steel Syndicates, have apparently not formed the subject of Government complaints on the ground of being excessive.

Large Glass Switchboard.—Recent developments in the making, bevelling and drilling of massive slabs of glass have made it possible to utilise this substance in the construction of switchboards.. A glass switchboard built for Dodge Bros., Detroit, Mich., by the Mutual Electric and Machine Co., Wheeling, W. Va., is declared to be one of the largest switchboards of this type ever made. The board is of white Carrara glass, and is 1·5 in. thick. All instruments are finished in golden bronze to add to the pleasing appearance of the apparatus as a whole. The board is in the engine room, and is used only for control purposes. The generator and feeder switches are operated by solenoids and motors, and are on additional switchboards in the basement and other parts of the factory. Mounted on the switchboard is a set of remote-control field discharge switches and "I-T-E" motor-operated circuit-breakers. To the left and right of the control switches on the glass board are mounted red and green signal lamps. The board is used in connection with the control of two 480-volt, 750-KW. three-phase 60-cycle steam-turbine units, one 500-KW., three-phase Corliss engine directly connected unit, one engine-driven exciter and two motor-generator exciter units.—*Electrical World.*

TRADE OF NEW ZEALAND.

THE following remarks relative to the trade of New Zealand in 1913 and Great Britain's participation therein, are extracted from the recently-issued report to the Board of Trade by H.M. Trade Commissioner (Mr. W. G. Wickham). This report (Cd. 7,693) can be purchased from Messrs. Wyman & Sons, Ltd., price 2½d.

General Trading Position.—The year 1913 was remarkable in several respects. It was a year of high prices, and a year of record trade in nearly every country. The total imports and exports of New Zealand for 1912 and 1913 were as follows:

	1912.	1913.	Increase.
Imports	£20,977,000	£22,286,000	£1,309,000
Exports	£21,771,000	£22,987,000	£1,216,000

The above figures include bullion and specie exported and imported, and it may be noted that, while the value of these latter exported has fallen by £82,600, the value imported was greater in 1913 by £234,675. The margin of gross exports over imports is slightly reduced on the year, but if specie be left out of account it is greater, as appears below:—

	1912.	1913.
Imports, excluding specie	£20,576,500	£21,652,000
Exports ,, ,, ...	21,511,600	22,810,000
Excess of exports	935,100	1,158,000

The general boom in trade had its usual somewhat inconvenient corollaries, namely, dear money and slow delivery of goods. The effect of a tight money market has been naturally to restrict public expenditure on development where this entailed further borrowing, this being reflected in a limitation of imports. It has doubtless also had the wholesome effect of promoting a spirit of commercial introspection. Communities and individuals are alike apt in times of cheap money to forget that credit is not the same as cash, and that liabilities have to be met in the long run.

Criticisms of British Methods.—The other direct result of a trade boom is the difficulty experienced in getting reasonable delivery. During the past year much adverse criticism was levelled at British manufacturers, in contrast with those of other countries, on account of the impossibly distant dates they name as the earliest shipment they can give. Consequently, they are blamed for lack of initiative in not expanding their works when they have the chance. Firms who are in the groove of a level turnover do not realise that in a period of boom they can, by giving prompt delivery of their goods, get trade at the expense of old-established goods, and have the opportunity of getting a footing in a new market, which they could not get without difficulty otherwise, but which, having once secured, they can retain in slacker times. America is quick to take advantage of this class of opening and is a particularly dangerous rival in times of booming trade. It would seem that the British manufacturer can be too cautious. His disinclination to take part in the expansion of a boom is doubtless due to his foreseeing the prospect of idle hands and plant during the lull in trade, if he has installed additional machinery in order to take boom orders. But if he do not venture, let him remember that he is not merely allowing a commercial rival to sell his wares during the boom period, but is permanently increasing competition and his own difficulty in selling in normal or slack times. Added to which he has allowed his customers to acquire a suspicion that the newcomer is more pushing, more up-to-date, and more likely to adapt himself to requirements.

It is probable that quite as much business is lost by manufacturers through wrong methods of attacking markets as through lack of initiative. But the old generalisations as to British manufacturers refusing to adapt themselves and their goods to foreign requirements still persist, so those who have British goods to sell must face criticism and scepticism and be ready to prove their ability. Occasional stupidities are apt to be exaggerated into national characteristics, and so damage British trade as a whole. One may therefore plead justification for dwelling on one or two lapses. A failing which is probably a heritage from the days when very few manufacturers did their own exporting, lies in the matter of packing. Manufacturers seemingly will not study effective and economical packing, and, what is more provoking, will not quote a price to include packing. It is as if they do not realise that the ultimate retail price is the factor of importance in capturing trade. For example, a number of stoves were shipped in their cases fitted up ready for use, instead of taken to pieces. These stoves were actually manufactured in separate pieces, with screws for joining them together; moreover, the indentors had actually stipulated that they should be taken to pieces for packing. A very much cheaper stove shipped by another British manufacturer and properly packed cost to land about 60 per cent. of its price at works, while the more expensive one cost over 90 per cent. of its price, and was so rendered unsaleable, except at a heavy loss.

Methods of Distribution.—Partly through the retailer wishing to get into closer touch with the manufacturer, with the idea that he would thereby save intermediate profits, and partly through the desire of the manufacturer to learn more directly what was wanted, and to exhibit his wares through an agent in personal touch with the consuming market, the middleman is being ousted and direct trading resorted to in

his place. This change has, so far as one can judge, come to stay. If it pays to sell through an agent in the, at present, limited or scattered market of New Zealand, it would appear likely to pay better and better as the market grows.

The following are, roughly, the alternative methods of dealing with the Dominion of New Zealand:—

1. A manufacturer may sell only in the United Kingdom to warehousemen, indent agents, and buying agents of the large retailers.
2. He may even limit himself by confining sales for export to a single merchant house in the United Kingdom.
3. He may have a trading branch established in the Dominion.
4. He may consider that a single agent for Australasia (*i.e.*, all the States of Australia, New Zealand and some of the Pacific Islands) is competent to find all the business he needs.
5. He may think it preferable to divide his business among several agents to cover the different clearly-defined areas in the Commonwealth and the Dominion.

The consensus of opinion appears to be against the first and second of these equally, except when the manufacturer is working on too small a scale to be able to do his own exporting economically. On the other hand, it is useless to add export to manufacturing unless firms are prepared to study the economics of the former as carefully as they do those of the latter. And further, it must be clearly understood that it is worse than useless to appoint a sole agent unless the manufacturer is satisfied that he is capable, as well as desirous, of doing justice to the appointment; and in spite of the utmost loyalty of intention it is usually impossible to prevent goods reaching the Dominion by devious channels, and so seeming to go past the local agent.

The third alternative calls for no comment. The fourth is more open to argument. That it is a question of some importance is clear from the fact that there are some 700 British manufacturers who have a sole agent for Australasia located in Melbourne or Sydney, or in a few cases in some town in New Zealand. Expression is often given to the opinion that manufacturers have done this owing to a deficient knowledge of elementary geography and history, as shown in the belief that New Zealand is a State in the Commonwealth. While there may not be complete justification for this extreme view, it is true that the areas, the relative distances and consequent slowness of communication between parts of Australasia are not adequately realised. At the same time, it must be admitted that it is almost as difficult adequately to work Western Australia from Sydney as New Zealand. However this may be, there is no gainsaying the fact that many agencies granted for all Australasia are simply not worked so far as New Zealand is concerned; in other cases, again, the agent is content with one visit in two years, or with a periodical visit to the Dominion, not stopping in any but the four chief towns.

Need for Local Representation.—In the Trade Commissioner's view, it is thoroughly bad policy to have a single agent for Australasia, as in most cases it merely means either that the whole area is not effectively covered, or that the whole work is done by sub-agents, and the goods consequently loaded with an extra agency commission. In expressing this view, one class of goods must be excepted, namely, goods which for effective sale need expert knowledge. If an agent having expert knowledge can be found in New Zealand, well and good: if not—and it is by no means easy always to find a firm of experts who are not already fully engaged with agencies—it is better to have local sub-agents who can keep a look-out for local business, and call in the expert head agent, say from Sydney, when expert knowledge is required.

The class of goods referred to is, of course, machinery. It is annoying to a buyer, say the Engineer to a Harbour Board, to find the agent for an engine unable to discuss the technical points in a suggested variation from a standard model, and the local agent having justified his existence by getting into touch with possible business should be able to call in an expert head agent to clinch it. On the other hand, an expert sole agent for the whole of Australasia cannot possibly keep himself informed as to all the possible business over such a vast area, or afford time to follow up single-handed all the possible business of which he does hear. Further, the expert can post up the non-expert sub-agents as to selling points of his plant, and he can also watch the local conditions and keep the manufacturers advised as to modifications necessary to suit these conditions.

It may here be pointed out that business of this kind must be regarded as speculative as compared with the sale, say, of hardware and crockery, where a regular beat can be canvassed by journeys at regular intervals. In the sale of big plant, *e.g.*, crane installations or large engines, much time and expense must of necessity be wasted over business which does not materialise. Manufacturers must realise this in making terms with agents, and they should also endeavour to understand the local conditions as regards distances, frequency of communication between one point and another, and the consequent expenditure of money and time involved in endeavouring to secure orders.

The Trend of Import Trade.—The New Zealand Import Returns are based for the most part on the country from which goods were last invoiced, which may not be the country where they were manufactured. Only in the case of goods coming in under the preferential tariff is the country of origin reliably stated. Consequently the comparative figures which we give elsewhere in this issue must be taken merely as a general guide to the trend of the trade. The following remarks by the Trade Commissioner, however, refer to goods which are affected by the preferential tariff and whose real origin is therefore clear.

The statistics on the whole represent a very distinct improvement, but in a few lines there is an unsatisfactory loss of trade. The most noticeable item is hardware and hollowware. Tinware also shows disappointing figures. Another heading where the United Kingdom's share is poor is "Metal, manufactured goods unenumerated." In the two last-named categories, Germany lost ground as well as Great Britain, the United States being the country which improved its position.

In portable and traction engines, we find a somewhat disconcerting transference of trade in a peculiarly British line. A severe drop in the share of the United Kingdom is accompanied by a strengthening of the United States' position.

There was a considerable drop in imports of gas-making plant and pumps and mining machinery, but these lines depend rather on chance orders, and a small import one year may be followed by a large one the following year. Cement is being satisfactorily manufactured locally, which accounts for a drop in imports having taken place in spite of the increasing demand for reinforced concrete.

In steam engines, other than locomotive, portable, and traction, the very heavy fall is difficult to explain. The increase in gas and oil engines was less than half of this fall, and the only explanation seems to be that tightness of money during the year has caused a check in industrial expansion needing steam engines as prime movers. No ground, however, has been lost in proportion to relative sources of supply.

A year ago attention was called to the extent of foreign competition in lamps, especially from Germany and America. In 1913, however, both of these countries lost ground, and, in spite of a slight reduction in total imports, the United Kingdom has improved her position.

The above remarks refer to important lines where the total trade of the year has shrunk. Turning now to those where there has been expansion, and especially lines where the proportion from the United Kingdom has improved, there is a good deal that is noteworthy under iron and steel manufactures. In such lines there is very little competition with the United Kingdom, partly, no doubt, because the very considerable extra duties on foreign goods cause the inferior Belgian and German makes to cost as much as better British qualities, and so take away the only inducement to buy them.

Canadian competition in drawn steel pipes and tubes has been maintained. Imports of wire rope increased considerably. In nails we have less than half the trade, but have slightly improved our position. British wire appears to be tougher than foreign and so better for tensile purposes; but for nail making the harder and more brittle German and American wire would seem to be better liked.

In the machinery group there is no sensational change. Gas and oil engines again increased by £10,000. Imports of belting other than leather have increased to £40,000, and the proportion from the United Kingdom has advanced from 75 per cent. to 85 per cent. at the expense of Japan and Germany. The former is the chief competitor.

In connection with the growing trade between New Zealand and the North-American Continent, it is interesting to note the increasing freight facilities for this interchange. As bearing out comments previously made on the operation of the preferential tariff in indirectly assisting the United States in competition with the United Kingdom, it may be of interest to quote the statement, to which considerable publicity has been given in the New Zealand press, of an ex-Governor of Massachusetts who is manager of a large American machinery manufacturing concern. He states that all over the United States "the tendency among the principal manufacturing concerns is towards the establishment of plants in Canada." He adds that this movement has been going on for many years, and estimates that from three to five hundred million dollars of American capital is now invested in these Canadian plants.

The Electrical Industry in Italy.—From statistics recently published, brought up to the end of March, 1914, it appears that the Italian companies concerned in the production and distribution of electricity number 151, having 302 stations at work, with a production equal to 763,000 H.P., while nine stations are under construction, with a capacity of 125,000 H.P. The capital employed by these companies amounts to 453,000,000 lire; the reserve funds total 32,500,000 lire; debentures, 146,000 lire; debts, 265,000,000 lire; plant, 732,000,000 lire, and securities and credits, 188,000,000 lire. Of these companies, 125 made profits of 34,000,000 lire, 11 made a loss of 8,000,000 lire, and 15 succeeded in making a balance only. The data regarding firms engaged in the output of electrical machinery are as follows:—The number of such firms is 16, employing power to the extent of 3,310 H.P., a capital of 36,000,000 lire, with reserve funds of about 3,000,000 lire, debts of 46,000,000 lire, plant valued at 29,000,000 lire, stock to the value of 29,000,000 lire and securities and credit, 45,000,000 lire. The profits made by 14 of these concerns totalled 2,600,000 lire, while the remaining two made a loss.

THE BARTON POWER SCHEME OF THE MANCHESTER CORPORATION.

As many of our readers are aware the Manchester Corporation Bill, which received Parliamentary sanction last year, allows, amongst other things, of the Corporation proceeding with an ambitious electrical scheme, which has become necessary owing to the rapid increase in the demand for electricity in the Manchester area.

At the present time the city is supplied from three generating stations—Dickinson Street and Bloom Street stations, which supply direct current in the centre of the city, with a combined plant capacity of 14,000 KW., and Stuart Street station, in the Clayton district, which supplies alternating current at 6,600 volts pressure to numerous sub-stations, and has a plant capacity of 55,500 KW.

In connection with the Stuart Street station there are 22 sub-stations—excluding those on consumers' premises—with an installed capacity of 33,000 KW. One of these is at Dickinson Street, where the generating plant was unequal to meeting the demand for electricity in the adjoining area.

To meet the requirements of the large power users, the Corporation has also equipped 58 sub-stations on consumers' premises, with an installed capacity of 34,500 KW.

FIG. 1.—SHOWING THE MANCHESTER SUPPLY AREA IN RELATION TO THE PROPOSED BARTON GENERATING STATION.

[Supply area includes Middleton (bulk), Failsworth, Droylsden, Audenshaw, Denton, Heaton Norris, and (for traction) Sale, Timperley and Altrincham.]

Existing generating stations shown as black spots, and sub-stations as rings.

The area over which supply powers are held now amounts to 46 sq. miles, with an estimated population of 750,000, exclusive of the Middleton area, to which a bulk supply is given.

The electrical demands of the area can be gathered from the fact that nearly 155 million units were generated and 118 million units sold during the year ending March 31st, 1914, and that the maximum demand of about 50,000 KW. is increasing at the rate of some 5,000 KW. a year under normal conditions. All the existing stations are limited in capacity by reason of water facilities for condensing purposes, and the existing buildings at Stuart Street will be full up with an installed capacity of 60,000 KW., the adjoining spare land being required for coal-storage purposes.

In view of the limitations mentioned, particularly as regards the Stuart Street station, the effective capacity of

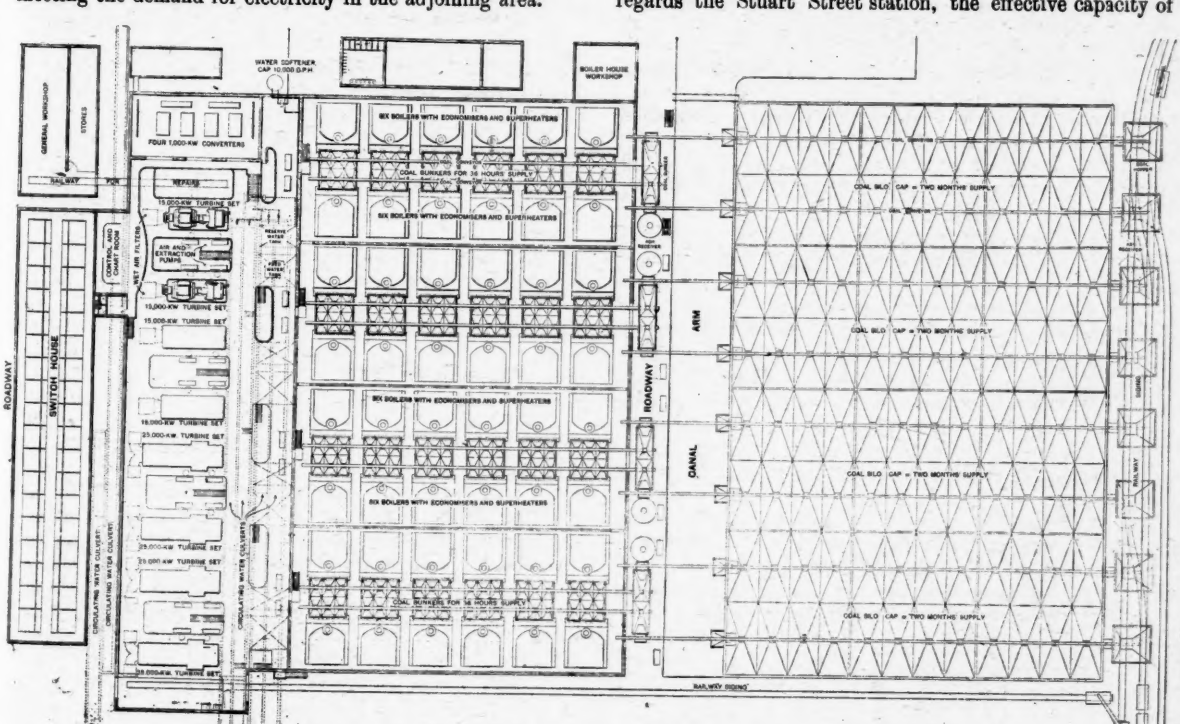


FIG. 2.—PLAN OF THE PROPOSED BARTON GENERATING STATION, MANCHESTER, COMPLETE WITH COAL SILOS, &C.

which for generating purposes will be reached when the maximum demand attains to 45,000 KW., allowing for reserve plant, it was decided that further generating plant in a fourth station should be available by the summer of 1917.

With this object in view numerous sites were inspected by the representatives of the Corporation, who were faced with a problem considerably in advance of anything yet attempted in the way of municipal electricity supply, as the projected ultimate capacity of the new station will be some 160,000 KW.

The site actually selected for what is now known as the Barton generating station covers 12 acres, and is situated at the extreme western end of Trafford Park, on the side of the Bridgewater Canal, and in the parish of Davyhulme.

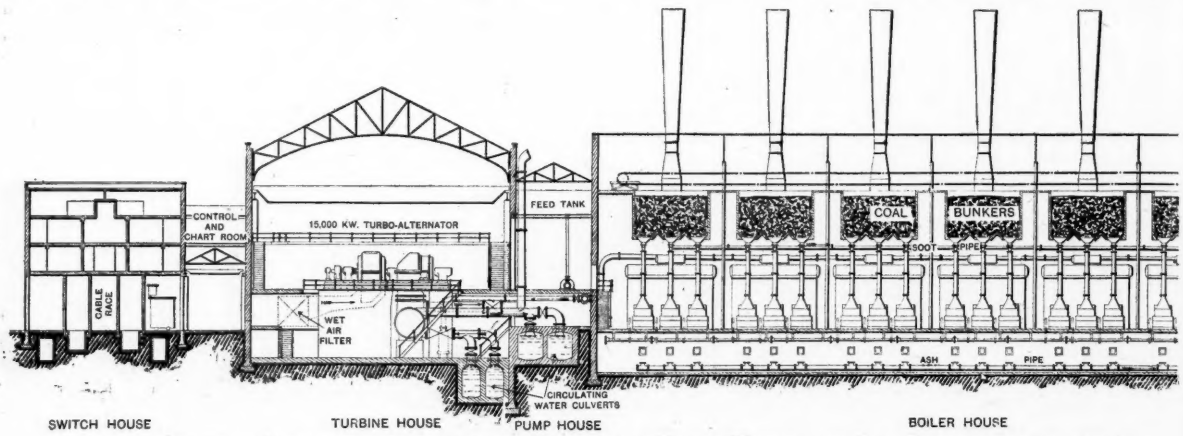


FIG. 3.—SECTIONAL ELEVATION THROUGH SWITCH, TURBINE AND BOILER HOUSES, AND COAL SILOS OF THE PROPOSED

This site fulfills the necessary conditions as to fuel, water, length of transmission lines and foundations, as by means of the Bridgewater Canal the West Lancashire coalfields are easily accessible, being only four miles away, while the Trafford Park railways provide through communication with the English coalfields generally. In the matter of water for condensing purposes, the site is also convenient to the Manchester Ship Canal. As, however, the consent of the Canal Co. to the use of the water is at present withheld, it is proposed to use the sewage and subsoil water—in the form of a purified effluent—which passes down the main outfall sewers to the Corporation's sewage works at Davyhulme, situated some 1,400 yards from the Barton site. The Barton site is about five miles from the centre of the city, being actually nearer than an alternative site within the city area, which met with some favour; trial borings have also shown as regards foundations that red sandstone rock underlies the whole of the site at a depth ranging from 7 to 8 ft., and, further, there are good grounds for considering that at least 1½ million gallons of good quality water can be pumped from boreholes in this rock every 24 hours.

It will be necessary to construct a new bridge across the Bridgewater Canal to carry coal and railway traffic to the station.

The preliminary plans of the generating station, which we are able to reproduce, show that not only will it be the largest power station in the kingdom, so far actually projected, but that it will be essentially a "big unit" station.

It is proposed to erect it in four sections, each of which will contain two complete steam-raising, electrical-generating and auxiliary plants, thus providing eight complete plants in the station. This allows of one spare plant, one set aside for repairs, and six plants in commission. As proposed the first four generating units will be turbine sets of 15,000 KW. each, and the remaining four, similar sets of 25,000 KW. each, making a total of 160,000 KW.

The arrangement includes four boiler houses, each with two batteries of water-tube boilers facing on to a central firing floor, *i.e.*, one battery of boilers for each turbine set, and four coal silos practically forming extensions of the boiler houses, but separated from the latter by a canal dock for the reception of water-borne coal.

Preliminary estimates show that 500,000 tons of coal per annum will be required by the complete plant and the canal can handle at least 1,000 tons a day, while over the Trafford Park railways 300 tons of coal an hour can be handled, sidings being provided for its reception.

The coal silos, to which reference has been made, will hold a two months' supply of fuel; each silo will be equipped with two endless bucket type conveyors into which rail-borne coal can be fed through hoppers below rail level, situated at one end of the silo, while water-borne coal received in the dock will be fed into hoppers at the other end. For this purpose the dock between the boiler house and silos, which will be roofed in, will be provided with a travelling crane with a bucket or grab for removing coal from the barges. Each silo conveyor will run across the dock and empty into an elevated coal hopper at the end of the adjacent boiler house, returning through a tunnel under the dock and silos.

The elevated coal hopper in turn will feed two endless bucket conveyors situated (both lead and return) over the bunkers in the adjacent boiler house, which are designed to carry 36 hours' fuel supply.

Only one section of the station, viz., 30,000 KW. of plant, is contemplated in the first instance, and 10 water-tube boilers, each with a normal rating of 50,000 lb. steam per hour, and complete with its own superheater, economiser, induced-draught plant and chimney – the Prat system being proposed in regard to the latter.

The suction ash system is proposed for the removal of the ashes and soot, the pipe systems leading to receivers on the canal dock side, which will discharge into barges, and to other receivers at the end of the coal silos, which discharge into railway trucks.

The first section of the generating plant will consist of two 15,000-KW. turbo-alternators generating three-phase current at 6,600 volts, 50 cycles, with a speed of 1,500 R.P.M., and developing their normal output at ·85 power factor.

A generating unit of this size has been in use at the Stuart Street station for some time, and was described and illustrated in the ELECTRICAL REVIEW of July 3rd, 1914.

The main cables from the generators will run direct to step-up transformers for raising the transmission pressure to 33,000 volts. These transformers and the necessary E.H.T. switchgear will be housed in a separate fire-proof switch-house; the switchgear, of the remote-control type, will be operated from a control gallery overlooking the engine house.

At the north-west end of the station there will be a sub-station, designed to contain four 1,000-KW. sets of converting machinery incidental to the supply and control of the auxiliary current required in the station, &c.; above the sub-station a 3,000 ampere-hour capacity battery for general direct-current supply and an excitation and switchgear trip-coil battery will be accommodated on the first and second floors. Between the engine house and boiler house a pump hall will be situated containing, as a first instalment, two steam-driven and one electrically-driven boiler feed pumps, each with a rated capacity of 25,000 gallons per minute, being provided; the upper part of the feed pump bay will

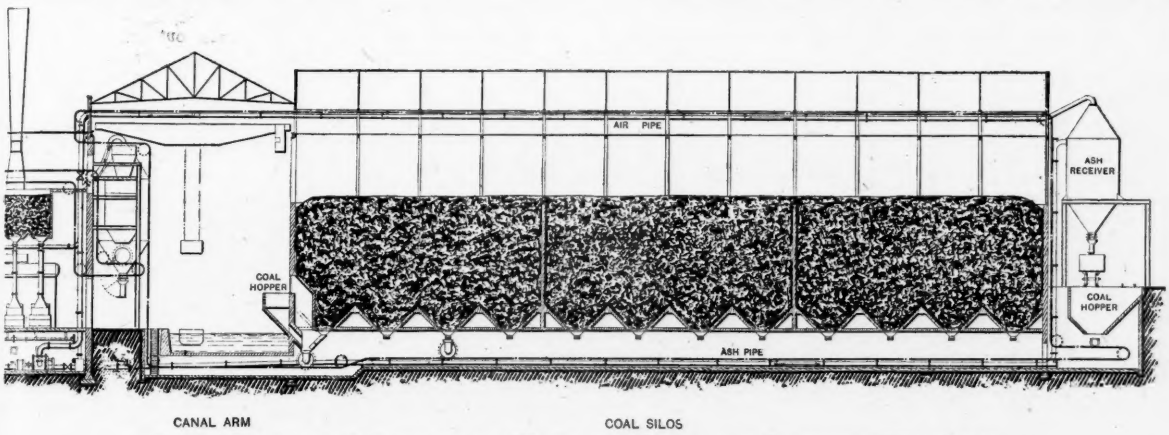
contain hot-well and reserve feed-water tanks. The feed make-up will be obtained from the Bridgewater Canal and treated in a water-softening plant. Between each pair of turbine sets there will be an open well containing the condenser auxiliary plant, and between the first turbine and sub-station there will be a repair well, with a railway track below at ground level, connecting with a general workshop forming a continuation of the switch house, but detached from it.

The dismantled machinery will be transferred by an overhead travelling crane on to a trolley in the repair well and passed straight into the workshop. At the other extremity of the engine house a similar unloading well will be provided, the railway track being in connection with the general railway

will result in important ecomomies in the subsequent purification processes. The roadway separating the engine room and switch-house will be roofed in and equipped with a travelling crane for lifting and moving the transformers from the adjacent switch-house.

The present designs contemplate for the complete station eight generators, and eight 33,000-volt feeders, running to a central distributing station in the existing area of supply —near which a large number of the existing H.T. feeders from Stuart Street station pass—where it is proposed to step down the pressure to 11,000 volts.

It is intended to utilise the existing Manchester H.T. 6,600-volt three-phase feeders for 11,000-volt working ; the existing feeders adjacent to the proposed distributing



BARTON GENERATING STATION, FOR THE MANCHESTER CORPORATION ELECTRICITY DEPARTMENT.

system. The design adopted provides a spacious engine room, as the pump hall at the side is open to the main building below the crane girders, and the sub-station will also be visible through three open arches.

Reference to the sectional elevation shows two circulating water inlet culverts below basement level, and adjacent to them two corresponding outlet culverts at higher level. These will be connected to the Davyhulme sewage works, it being proposed to erect a pumping station there, equipped with electrically-driven high-lift pumps, and with a sub-station overhead for controlling the supply to the sewage

station will be coupled to the 11,000-volt bus-bars in the latter, and suitable transforming arrangements provided at Stuart Street station and elsewhere in the area to utilise the higher voltage.

We understand that the switch arrangement at Barton provides for coupling the generator direct through the step-up transformer and duplicate oil-switches to its outgoing feeder. The machines will also be connected to a coupling bus-bar through 5 per cent. reactances, and a transfer bus-bar will be provided between the feeders.

Alternative routes are available for the feeders running

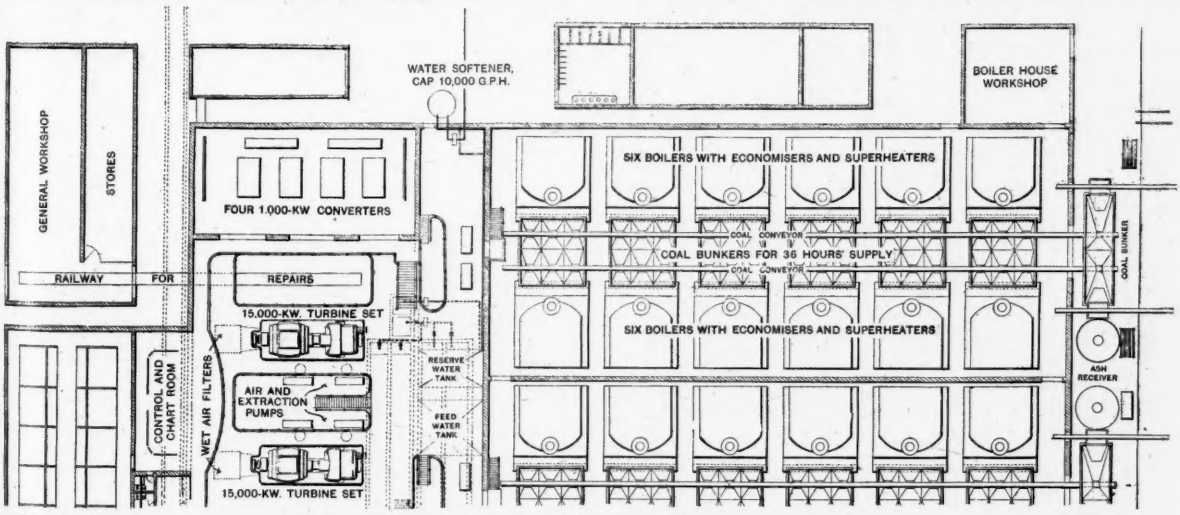


FIG. 4.—PLAN SHOWING ROUGHLY THE TURBINE AND BOILER ARRANGEMENT OF THE FIRST SECTION OF THE PROPOSED BARTON GENERATING STATION, AT MANCHESTER.

works. The purified effluent at these works will be drawn from a large storage reservoir, which will also fulfil the function of a settling tank, and pumped up to the generating station, where it will pass through extra filters before entering the condensers ; the discharge to the sewage works for final treatment will take place at a higher level than the intake, and, owing to this increased head, the capacity of the sewage works will be greatly increased. Moreover, the discharge effluent will gain some 15° in temperature, which

from Barton, *i.e.*, along the towpath of the Bridgewater Canal into the city at Cornbrook, and by the main road through Trafford Park to Old Trafford, and thence to the city.

The new distributing station will, if the present proposals mature, consist of two main switch and transformer buildings divided by a bay, which will be equipped with a travelling crane and lifting appliances for removing the transformers from the adjacent buildings. Each half

of the station will be coupled to four 33,000-volt feeders and equipped with 33,000-volt and 11,000-volt ring bus-bars.

Parliamentary estimates of the operating cost of the Barton station, on a 40 per cent. station load factor, and with coal at 9s. per ton, show works costs ·138d., capital charges ·088d., or a total cost per unit, apart from administration charges, of ·226d., this figure comparing with a similar total cost for Stuart Street station, with a 37 per cent. station load factor, of ·383d. per unit.

On the present annual output from Stuart Street the difference in favour of the new plant would be nearly £57,000 a year.

The estimated capital cost of the completed Barton station, including the culverts to Davyhulme, is £11 per KW.

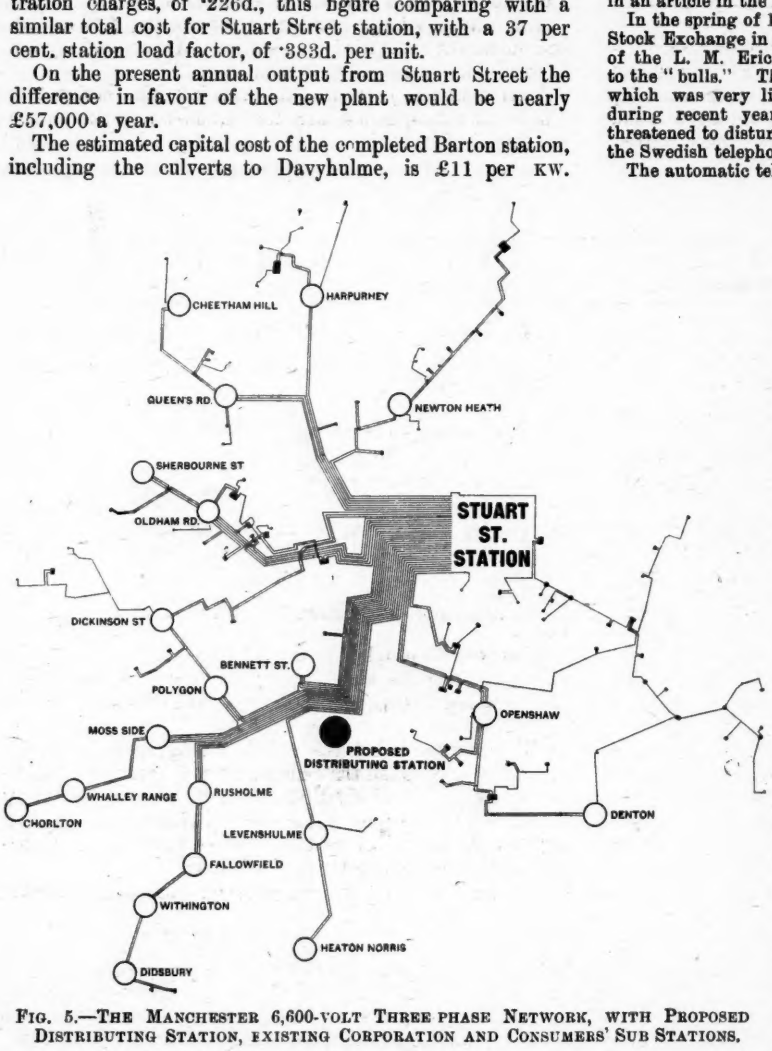


FIG. 5.—THE MANCHESTER 6,600-VOLT THREE PHASE NETWORK, WITH PROPOSED DISTRIBUTING STATION, EXISTING CORPORATION AND CONSUMERS' SUB STATIONS.

Except as regards its adjacent situation, the Barton station will, under present arrangements, have no connection with the growing manufacturing area of Trafford Park, where, at the present time, many concerns possess their own power plants, and the local power supply in the Park averages under 3,000 KW., representing some seven million units a year.

We believe it is no secret, however, that the existence of the huge plant at Barton, in close proximity to the Ship Canal and this favoured manufacturing area, is expected to lead to far-reaching developments in the future.

In conclusion, we are indebted to Mr. S. L. Pearce, the chief engineer of the Manchester Electricity Department, for permission to publish these preliminary details of the scheme for which he is responsible, and which is a considerable advance on anything of the kind in this country. We have drawn where necessary on his Parliamentary evidence in support of the scheme, and are indebted to him for the plans and drawings which we reproduce.

A Fifty Years' Anniversary.—On January 1st, MESSRS. W. J. STOKVIS, LTD., of Arnhem, Holland, specialists in electrical fittings design from the old Dutch masters, celebrated the completion of 50 years' establishment of their business as an industrial concern.

THE TELEPHONE INDUSTRY IN SWEDEN AND ELSEWHERE.

IT is well known that Sweden occupies a leading position in the telephone industry, and as the present state of affairs is not altogether satisfactory in some branches, it is of interest to see how the matter is regarded by the Swedes themselves, as indicated in an article in the *Affarsvarlden*.

In the spring of 1912 there was keen interest on the Stockholm Stock Exchange in telephone shares, and especially in the shares of the L. M. Ericsson Co., which resulted in a considerable loss to the "bulls." The market was infected by a certain nervousness, which was very likely due to the new technical methods which, during recent years, have been discovered, and which have threatened to disturb even the fundamental principles on which the Swedish telephone industry has been built and prospered.

The automatic telephone of Betulander has been disposed of to the Marconi Co., which, no doubt, intends to make a big thing out of it, although the experiments with it have not been concluded as yet. The large electrical companies in Germany have also a number of new inventions in hand, and have been making preparations in order to put them on the market. In the case of the English L. M. Ericsson Co., it will be seen in the last report that the sale of their products has been found to be insufficient, and it has consequently been decided to take up the manufacture of cheaper apparatus of a more simple construction. The subsidiary American Co. has for some years up to, and including, 1912 been run at a loss, for which reason the Swedish Co. has been obliged to write off a large amount on the shares in the subsidiary company. There are also certain symptoms which show that the free markets for telephone materials are tending to become more restricted, and sales are thus not so easy now, because they are becoming more and more dependent on the interests, which the buyers or the large consumers, who have monopolised concessions in various forms, have in common with the sellers.

In America the Bell Trust rules with nearly despotic authority over 8 millions of subscribers, and is able to control sales altogether. On the other hand, the Swedish industry has been able to hold its position, and has even made good progress. The value of goods exported from the L. M. Ericsson factories rose in 1913 to £444,450, as compared with £405,550 in 1912 and £388,900 in 1911, and the turnover of the Russian subsidiary company has grown considerably, as is also the case with the companies at Vienna and at Buda-Pest. A considerable portion of the Swedish exports is, however, going to the subsidiary companies at Warsaw and Moscow, and in Mexico.

The supply of telephone materials has lately become more and more dependent on the financing of new telephone systems. If such systems are promoted by the State, the latter is always inclined to favour the home manufacturers as much as possible, and if the concessions are held by private companies, these are sure to favour the telephone manufactories with which their leaders may have financial connections of some sort.

The telephone industry thus stands in intimate contact with finance, and it is a fact that the greatest victories of the Swedish telephone industry during recent years are partly due to the co-operation of Swedish financiers. The concessions at Moscow and Warsaw of 1900 were secured chiefly by the direct work and by the personal visits of the financiers, Mr. Wallenberg and Mr. Glückstadt, and the Mexican concession of 1905 was also due to Mr. Wallenberg, while the erection of the branch works at Paris, Vienna and Buda Pesth may be attributed to bank director Fränekel, and his connections and personal visits to the said places. All these represent splendid examples of what can be done, when men of the industry and finance are working in co-operation. At the present time it is rare to get a large concession for telephone lines without the concessionaire being prepared to offer the State or the municipality concerned a substantial reward in the form of a loan.

This was the case with the important concession at Constantinople, and the tendency in this direction seems to grow. There is a considerable amount of capital in the country, and Sweden has managed to finance a number of enterprises abroad, but there is also a requirement for foreign capital, and in the case of the Russian concession a sum of 15 million francs was obtained in France in the form of a mortgage at 4½ per cent. If the Swedish telephone industry is going to retain its position, it will thus have to seek co-operation with the world of finance, and the amounts in question at the present time are more than Swedish capital alone can supply. By a prudent combination of the Swedish technical superiority in the telephone industry

and the financial resources of England and France splendid results ought to be achieved.

In China, in 1911, a plan was prepared on a large scale for a re-arrangement of the entire telephone service, comprising plans for the building of telephone lines and of telephone manufactories. It has, however, been impossible to do anything owing to lack of capital and on account of the political conditions. The latter are now gradually improving, but the want of capital is now greater than ever before, and there is an unprecedented bargaining with concessions against ready cash. The L. M. Ericsson Co. during the years 1911 and 1912 took the trouble to investigate the Chinese conditions at an expense of nearly £2,000, and should thus be fairly well acquainted with the state of things there. There ought now to be a good opportunity to get hold of important concessions, in which French and English capital might co-operate with the Swedish industrial ability, and both secure excellent profits. It is not the intention to give the details of such a plan here, but our contemporary says France, for instance, might very well give large loans on the concessions, and the most important places could thus be supplied with telephones and telephone lines, while the materials for the same could be supplied either from Sweden or from local manufactories to be erected in various places. The State or the municipalities in China ought also to be interested by being offered a certain portion of the profits, or by getting a certain number of free shares in the prospective companies. It could also be regarded as a certainty, that the Chinese capitalists would contribute to the investments and the more so, as the main company would be of Swedish nationality, which in political respects must be regarded as a neutral country altogether.

It would, of course, be advisable to proceed with great caution and not quicker than the political conditions might warrant. It also stands to reason that such a scheme would be very complicated. But there is much to gain from such an enterprise, and it would mean a grand future to the Swedish telephone industry, if it were able to secure a large portion of the sale to a country with 400 million inhabitants. There are also certain Balkan States, which no doubt would be quite willing to entertain a proposition in the direction indicated above owing to their financial difficulties.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Jowers's Protective Leakage Device.

To obviate the inconvenience and loss caused by a small motor breaking down to earth and tripping the switch controlling the supply to a whole group of motors, the GENERAL ELECTRIC CO., LTD., of Witton, Birmingham, have introduced a device which

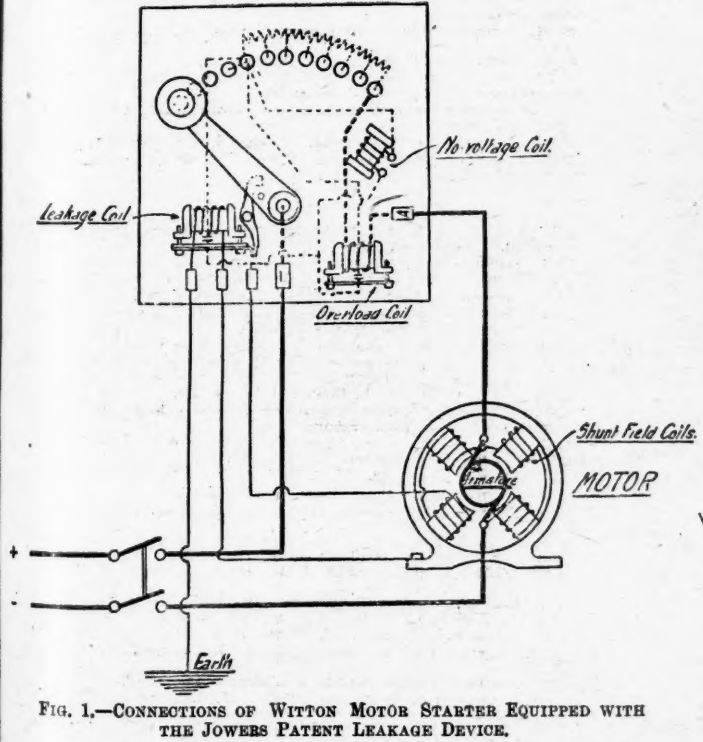


FIG. 1.—CONNECTIONS OF WITTON MOTOR STARTER EQUIPPED WITH THE JOWERS PATENT LEAKAGE DEVICE.

can be fitted to their standard D.C. motor starters. With this device the motor is completely insulated from earth, except through the usual earthing conductor, in series with which is inserted a low-resistance trip coil.

Leakage current flowing through the trip coil actuates a mechanism which short-circuits the no-volt coil if the motor is running, and shuts it down; while if the motor is standing, the leakage current actuates a catch which locks the starter arm, preventing any attempt at starting.

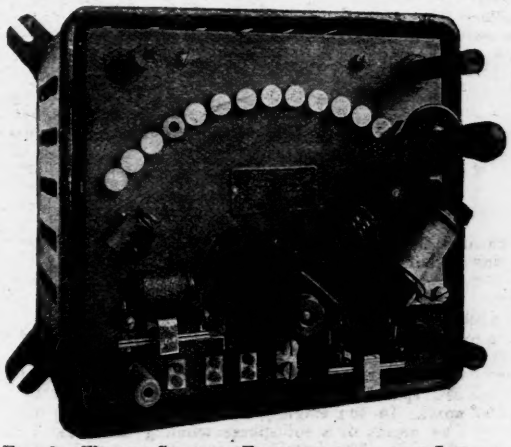


FIG. 2.—WITTON STARTER EQUIPPED WITH THE JOWERS DEVICE.

The Jowers device is claimed to safeguard the supply and the operative, since a faulty motor is immediately cut out of circuit.

The connections for this device and the additional coil on the Witton starter are shown in the accompanying views.

New Street Lighting Reflector.

With a view to improving street lighting whilst still complying with the requirements of the authorities as to reduced illumination, by cutting off the upward rays and producing a minimum illumination over a maximum area, MESSRS. A. W. BEUTTELL, LTD., of 109, Victoria Street, Westminster, S.W., have designed an aluminium reflector, whose general appearance is shown in fig. 3. The reflector is provided with a suitable opening at the top, so that it may be slipped over the existing lamp or lamps and adjusted in the correct position relatively thereto. The performance of the reflector is shown by the light distribution curve given in fig. 2, from which it will be noticed that it is of the extra-intensive type with the maximum illumination at an angle of 30°

FIG. 3.—BEUTTELL REFLECTOR.

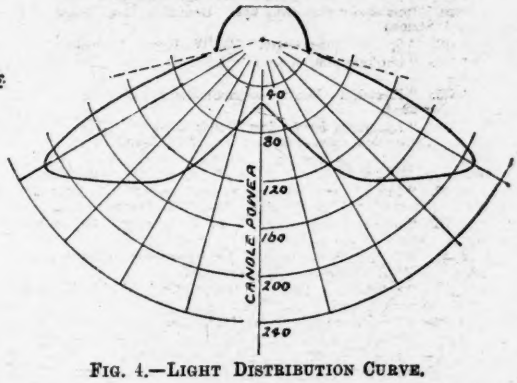


FIG. 4.—LIGHT DISTRIBUTION CURVE.

and as nearly ideal for street lighting as is practicable under the circumstances. This reflector is now ready for the market, and the makers will be pleased to co-operate with central station engineers with a view to adapting it to their individual requirements.

Reactive-Factor Meters.

Although instructed to keep the power-factor of the circuits over which they have control as near unity as possible, switchboard attendants often think that a power-factor of 1 or 2 per cent. less than unity is good enough and do not try to improve it. If instead of the power-factor meter use be made on the circuit of a reactive-factor meter, a condition of 98·5 per cent. power-factor is indicated as 17·5 per cent. reactive factor, and the attendant will be more apt to improve it.

A reactive-factor meter, which has recently been introduced by the WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., East Pittsburg, Pa., operates on the rotating-field principle in a manner similar to that of a power-factor meter placed on the market by the same company. A rotating field is produced in angularly placed coils connected in shunt with the metered circuits, one being used for each phase of the system in the case of polyphase meters. A movable iron vane or armature is placed in the field and is magnetised by a stationary coil, the current in which is proportional to and in phase with that of the line current in one phase of the circuit. As the iron vane is attracted or repelled by the rotating field of the angularly placed coils, it takes up a position in which the zero of the rotating field is indicated at the same instant as zero of its own field. Thus its position gives the phase angle between the voltage and the current of the circuit.

The reactive-factor meter is calibrated to read the sine of the angle indicated, while the power-factor meter is calibrated to read the cosine. In the three-phase meter the rotating field is produced by three coils spaced 60° apart and in the two-phase meter by two coils 90° apart. In the single-phase meter the rotating field is produced by means of a split-phase winding connected to the "voltage" circuit. The meters are enclosed in round dust-proof cases and are built in two sizes, the diameter of one of which is 7 in. and of the other 9 in.—*Electrical World.*

G.E.C. Opal Shades.

THE GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C., have, in conjunction with an old-established firm of English glass manufacturers, introduced a new opal shade, in the "Ogee" shape, as shown in fig. 5. The shape is adapted to the

FIG. 5.—NEW G.E.C. OPAL SHADE.

needs of the tungsten lamp, and is stocked in two sizes, 7 in. diameter and 9 in. diameter by 4 in. deep; the glass is claimed to be an improvement in colour on the usual foreign-made conical pattern.

NEW PATENTS APPLIED FOR, 1914.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

24,368. "Fuses or cut-outs for electric circuits." V. HOPE. December 21st. (Addition to 22,575/13.)

24,388. "Attachment for the illumination of prismatic or plain compasses or other surveying instruments." S. M. DIXON. December 21st.

24,398. "Process for the removal and recovery of tin and solder from tinned-iron scrap and the like." S. O. COWPER-COLES. December 21st.

24,419. "Moulded compositions and the process of making the same." BRITISH THOMSON-HOUSTON CO., LTD. December 21st. (General Electric Co., United States.)

24,428. "Sparking-plug tester." G. W. KING. December 21st.

24,441. "Cord-gripping devices." R. J. QUAINTON. December 21st. (Complete.)

24,475. "Electrical vibrator contact-makers and breakers." J. GARDNER. December 22nd.

24,496. "Apparatus for cooling electric motors." J. W. NOLAN. December 22nd. (Convention date, February 2nd, 1914, United States.) (Complete.)

24,498. "Telegraph systems and apparatus therefor." BRITISH INSULATED & HELSBY CABLES, LTD., and H. H. HARRISON. December 22nd. (Complete.)

24,502. "Incandescent mercury vapour lamps." F. BOUSSON. December 22nd. (Convention date, September 3rd, 1913, France.) (Complete.)

24,506. "Selecting mechanism." B. F. MERRITT. December 22nd. (Convention date, January 24th, 1914, United States.) (Complete.)

24,511. "Wire grip and contact for incandescent electric-lamp holders and other uses." H. MADDICK. December 23rd.

24,512. "Self-locking electrical lampholder." F. W. ROBERTS & H. GERSHAM. December 23rd.

24,537. "Double magnet." H. GROB. December 23rd. (Complete.)

24,543. "Electric meters." O. T. BLATHY. December 23rd. (Convention date, December 23rd, 1913, Hungary.) (Complete.)

24,545. "Switch-operating mechanisms." C. BURTON. December 23rd. (Complete.)

24,552. "Electrical resistances." A. H. CURTIS. December 23rd.

24,553. "Automatic and semi-automatic telephone systems." BETULANDER AUTOMATIC TELEPHONE CO., LTD., & D. C. CROWE. December 23rd.

24,554. "Automatic and semi-automatic telephone systems." BETULANDER AUTOMATIC TELEPHONE CO., LTD., & D. C. CROWE. December 23rd.

24,589. "Attachment for connecting the plug-tester to the sparking-plug in internal-combustion engines." F. SIRETT. December 24th.

24,604. "Variable-speed dynamo-electric machines." A. H. MIDGLEY & C. A. VANDERVELL. December 24th. (Complete.)

24,629. "Regulating means for electrical installations. SOC. ANON. DES ETABLISSEMENTS L. BLERIOT. December 24th. (Convention date, December 27th, 1913, Belgium.) (Complete.)

24,631. "Electric insulators." SOC. CERAMICA RICHARD-GINORI. December 24th. (Convention date, April 30th, 1914. Italy.) (Complete.)

24,637. "Control devices for electric clock systems." G. C. HATTON. December 24th. (Complete.)

24,644. "Sparking-plugs." R. O. C. HURST & F. B. MILLS. December 24th.

24,659. "Automatic magnetically-operated clutches for electric motors." J. G. STIRK. December 28th.

24,678. "Automatic switch-gear for reversing motors on planing machines and the like." J. G. STIRK. December 28th.

24,692. "Liquid rheostats." D. WERGE. December 28th.

24,697. "Electric connection boxes." SUNDERLAND FORGE & ENGINEERING CO., LTD., and G. C. REED. December 28th.

24,740. "Apparatus for the application of electric current to surgical purposes." H. W. HILL. December 29th.

24,741. "Cable winders." L. V. S. BLACKER. December 29th.

24,742. "Fittings for conduits for electrical conductors." A. W. SCLATER. December 29th. (Complete.)

24,744. "Series incandescent electric lighting circuits." G. A. GORANSSON. December 29th.

24,746. "Telegraphic transmitting apparatus and the like." S. WECHSLER. December 29th. (Complete.)

24,766. "Construction of solid-metal vapour lamps." H. J. S. SAND. December 30th.

24,780. "Electrically-operated alarm apparatus." J. F. X. MILLER. December 30th. (Complete.)

24,787. "Electro-magnetic circuit-controlling devices for railway signalling and other purposes." J. GARDNER. December 30th.

24,792. "Electricity meters." W. HAMILTON & FERRANTI, LTD. December 30th.

24,830. "Electric fire-control." A. H. POLLEN & H. ISHERWOOD. December 31st.

24,837. "Alternating-current dynamo-electric machines adapted for synchronous working." L. J. HUNT & SANDYCROFT, LTD. December 31st.

24,838. "Dynamo-electric machines." L. J. HUNT & SANDYCROFT, LTD. December 31st.

24,839. "Dynamo-electric machines having cascade-connected windings." L. J. HUNT & SANDYCROFT, LTD. December 31st.

24,841. "Machines for cutting the globes of electric incandesence lamps and the like." ALLIES ELECTRIC LAMP CO., LTD. December 31st. (— le Naour, France.)

24,844. "Portable mechanical electric flashing-device worked by clockwork." J. S. BENNETT.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & CO., 285, High Holborn, W.C., and at Liverpool and Bradford, price, post free, 9d. (in stamps).

1913.

24,871. VARIABLE CANDLE-POWER INCANDESCENT ELECTRIC LAMP AND SWITCH. W. G. Rhodes. November 1st.

25,171. ELECTRIC FURNACES. F. T. Snyder. November 4th.

27,477. CONTROLLING DEVICES FOR VARIABLE-SPEED DYNAMOS AND THEIR CIRCUITS. L. Renault. November 28th. (December 7th, 1912.)

27,571. FIRE EXTINGUISHING AND ALARM APPARATUS FOR USE ON BOARD SHIPS AND IN LARGE BUILDINGS. F. W. Smith & H. S. A. Warren. December 1st.

28,111. TRIPPING DEVICES FOR ELECTRIC SWITCHES AND THE LIKE. J. G. Statter. December 6th.

28,292. REGULATING DEVICES FOR ELECTRIC MOTORS. W. G. Haywood. December 8th.

28,409. TELEGRAPHY. F. G. Sargent. December 9th.

28,413. RECEIVERS FOR USE IN WIRELESS TELEGRAPHY. Marconi's Wireless Telegraph Co. & H. J. Round. December 9th.

28,527. ELECTRICAL CONTROL SYSTEMS AND SWITCH MECHANISM THEREFOR. R. Amberton. December 10th.

28,559. TELEGRAPH TAPE TRANSMITTER. D. Murray. December 11th.

28,897. VACUUM CLEANING APPARATUS. F. G. Hicks. December 15th. (Cognate application, 14,200/14.)

1914.

186. METAL VAPOUR ELECTRIC RECTIFIERS. Akt. Ges. Brown, Boveri et Cie. January 3rd. (March 22nd, 1913.)

1,154. ELECTRIC CIRCUIT CONTROLLING APPARATUS. Western Electric Co. (F. T. Woodward, acting for Western Electric Co.). January 15th.

1,972. DRY-CELL BATTERIES. C. W. Simmons. January 24th.

2,059. METHOD OF AND APPARATUS FOR AMPLIFYING AND REPRODUCING SOUNDS. L. de Forest. January 26th. (June 24th, 1913.)

2,249. ELECTRO-MAGNETIC UNLOCKING APPARATUS FOR MINERS' LAMPS. Oldham.

3,436. DRIVING MECHANISM FOR MULTIPLEX DISTRIBUTORS OF ELECTRIC TELEGRAPHS. D. Murray. February 10th.

3,530. ELECTRICAL SWITCH. L. Beretta. February 11th.

3,650. ELECTRIC CIRCUIT CONTROLLING DEVICES. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). February 12th.

4,167. MEANS FOR SUPPORTING RESISTANCE WIRE AND THE LIKE. Credenda Conduits Co. & V. Summerhayes. February 18th.

4,590. ELECTRIC LIGHT BULB. W. C. M. Pettingill. February 23rd.

7,677. ELECTRICAL RESISTANCES. J. Collinson. March 26th.

8,656. KEYBOARD TAPE PERFORATING APPARATUS. E. E. Kleinschmidt. April 6th.

8,699. ELECTRIC MOTORS AND ELECTRO-MAGNETIC CLUTCHES FOR DRIVING MACHINES. B. Graemiger. April 6th. (May 26th, 1913.)

8,855. ELECTRIC LIGHTING SYSTEMS OF MOTOR-CARS. B. Brooks & W. Holt. April 8th.

8,957. CIRCUIT-CONTROLLING DEVICES FOR ALTERNATING CURRENTS. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). April 9th.

9,351. NON-MAGNETIC COMPASS. E. Klahn. April 15th. (May 12th, 1913.)

10,619. TRAVERSERS AND THE LIKE FOR ELECTRIC RAILWAYS. T. F. Mullaney. April 29th.

11,492. IRONCLAD ELECTRO-MAGNETS. E. Gengenbach. May 9th.

11,610. SUSPENSION OF ELECTROLYTIC ANODES. H. R. Boissier. May 11th. (May 9th, 1913.)

11,920. ELECTRIC BATTERY LAMPS. W. J. Mellersh-Jackson (Interstate Electric Novelty Co.). May 14th.

12,057. ELECTRIC FURNACE PARTICULARLY ADAPTED FOR THE MANUFACTURE OF NITRIDES. G. Coutagne. May 15th. (May 23rd, 1913.)

12,605. ELECTRIC HEATING APPARATUS. J. Pate & A. R. Wood. May 22nd.

15,224. ELECTRICALLY-OPERATED WINCH, SPECIALLY APPLICABLE AS AN ASH HOIST. June 25th. (Addition to 20,853/13.)